

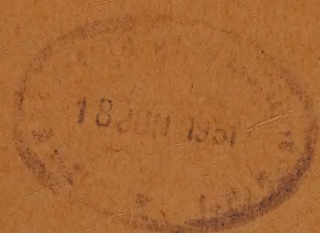
THE TOBACCO RESEARCH BOARD
of
SOUTHERN RHODESIA

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1950

**TRELAWNEY TOBACCO
RESEARCH STATION**

ANNUAL REPORT
for 1949



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RESEARCH STATION**

**ANNUAL REPORT
for 1949**



Report of the Tobacco Research Board for the Year ended 31st December 1949

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Plant Physiologist, (from Nov. 1949)				J. O. WHITESIDE, B.Sc.
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General

Notwithstanding the continued world shortage of trained agricultural scientists, fairly good progress has been made in building up an adequate team for tobacco research. At the beginning of the year the staff on the station consisted of the officer-in-charge assisted by seven professional officers and the farm manager.

The officer-in-charge resigned in June, 1949 to take up a farming career and the Senior Tobacco Research Officer assumed duty on the station during July. In August one professional officer was transferred to Karoi to take charge of the tobacco section on the Government Experimental Farm K34. The new post of plant physiologist was filled towards the end of the year and this officer assumed duty in November. Vacancies for an agricultural chemist and a plant breeder are still outstanding but it is expected to fill these posts early in 1950.

With the increase in staff a considerable expansion of the research programme has been possible.

Especially notable is the renewed intensive investigations on eelworm control and the intensification of research into problems of tobacco nutrition. With co-operation of the Chief Botanist and Plant Pathologist and his staff and the permanent residence of one of his officials on the station work on tobacco diseases has been greatly expanded.

The most pressing need at the moment is for more specialist scientists, better facilities for laboratory work and the provision of technical assistants to relieve the professional officers of much of the enormous volume of routine work so that they can devote more of their time to their main job of research.

Weather Conditions:

The seasonal rainfall was well below the average and was exceptional in that 4.5 inches of rain fell during the month of October. For the growing period from November to April the total rainfall was only 18.52 inches which for these months is the lowest ever recorded on the station. Planting conditions were very poor in that planting rains were followed by periods of bright sunshine which made the establishment of good stands extremely difficult. The rainfall was as last season very localised and the rain recorded at the laboratories was not always indicative of the amount falling on other parts of the farm. The desirability of recording rainfall separately in the experimental blocks was therefore again evident.

Growing conditions were difficult at first owing to the long drought periods which caused the plants to be very slow in coming away. Towards the end of the season conditions were more favourable and some heavy yields were recorded.

Disease and Insect Pests:

No serious outbreak of disease occurred; in fact, disease incidence was very slight owing mainly to the very dry season. All the more

common diseases were, however, recorded in isolated cases, i.e. Frog-eye, Alternaria, White Mould, Root-rot, Mosaic and Leaf curl.

The usual amount of loss at planting due to the activity of white grubs and wireworms was evident and crickets were quite troublesome in some experiments on the grey sand soils.

Presentation of Results:

The results have been evaluated and tabulated in the same manner as in previous seasons and the same standard prices based on samples have been used. The usual selling price was about six times the average prices given.

Acknowledgments:

We are again indebted to the Imperial Tobacco Company for the classification of samples and to the United Tobacco Company (Rhodesia) Limited for making up cigarettes from samples of tobacco for smoking tests.

The kind assistance and advice rendered by officials of the Turkish Co-operative, Darwendale, in carrying through the Turkish programme and in the provision of grading facilities was very deeply appreciated. Special thanks are due to Mr. O. C. Rawson and to Mr. Abrahams.

T A B L E I.
RAINFALL DURING SEASON 1948/49.

	1948 Oct.	1948 Nov.	1948 Dec.	1949 Jan.	1949 Feb.	1949 Mar.	1949 April	1949 May
1	—	—	—	0.74	0.17	0.31	—	0.02
2	0.42	—	0.28	0.02	0.15	—	—	0.14
3	—	—	0.97	—	0.29	—	—	—
4	—	0.22	0.08	—	0.90	—	—	0.23
5	—	—	0.36	—	0.19	—	—	—
6	—	0.78	—	—	—	—	0.02	—
7	—	0.57	—	—	0.14	—	—	—
8	—	—	—	—	0.23	—	—	0.02
9	—	—	—	—	—	—	—	—
10	—	0.29	—	—	—	—	—	—
11	—	0.06	—	—	—	0.31	—	—
12	—	0.57	—	—	—	—	—	—
13	—	—	—	0.44	—	0.12	—	—
14	0.24	—	—	0.12	—	0.30	—	—
15	—	—	—	—	—	—	—	—
16	—	—	—	—	—	—	—	—
17	—	—	—	0.10	0.04	0.14	—	—
18	0.03	—	—	0.06	2.14	—	—	—
19	0.50	0.79	—	0.25	0.49	—	—	0.02
20	0.12	0.04	0.09	0.06	—	0.05	—	—
21	2.08	0.44	0.12	—	—	0.09	—	—
22	—	0.25	—	—	—	—	—	—
23	0.70	0.06	0.07	0.12	—	—	—	—
24	0.40	—	0.02	—	—	—	—	—
25	0.01	—	0.06	0.56	—	—	—	—
26	—	—	—	—	—	0.09	—	—
27	—	—	—	0.10	—	—	0.37	—
28	—	0.83	—	0.17	1.25	—	0.18	—
29	—	—	0.37	0.23	—	—	—	—
30	—	0.04	0.10	0.02	—	—	—	—
31	—	—	0.04	—	—	—	—	—
TOTAL ...	4.50	4.94	2.56	3.05	5.99	1.41	0.57	0.43

ANNUAL TOTAL — 23.45 INCHES.

II. Agronomy

A. ROTATIONS

During the 1948/49 season three series of rotational experiments came under test tobacco. They were:

Experiment H. A three-year course rotations, i.e. one season tobacco, two seasons of crops followed by one season tobacco, on light grey sand. This was the second completed rotation, the first being completed in the 1945/46 season.

Experiment J. A five-year course rotation, i.e. two seasons tobacco, three seasons rotation crops followed again by two seasons tobacco. This was the final year, i.e. second crop of tobacco following crops. The soil is a pinkish grey sand somewhat heavier than the H. land.

Experiment K. As experiment J. on red contact sand. The test tobacco was the first crop following rotation crops.

H. THREE YEAR COURSE ROTATION.

The following rotations were tested:—

Treatment	1942-43	1943-44	1944-45	1945-46	1946-47	1947-48	1948-49
No. 1	2nd yr.	as	as	Tobacco	P.T.B.	P.T.B.	Tobacco
No. 2	Tobacco from	1946-47	1947-48	"	S'hemp P.U.	Maize	"
No. 3	Virgin land	"	"	"	Maize	S'hemp P.U.	"
No. 4	"	"	"	"	Munga	Fallow	"
No. 5	"	"	"	"	Maize	Velvet Beans. C.H.	"
No. 6	"	"	"	"	Cotton	S'hemp P.U.	"
No. 7	"	"	"	"	Fallow	Fallow	"

P.T.B. Purple Top Buffel Grass.

C.H. Cut for Hay.

P.U. Ploughed Under.

EXPERIMENTAL DATA

Soil. Light grey sand originally opened in 1941.

Rotation crops. 1947/48 season.

All crops were fertilised and reaped according to normal practice. They were ploughd under on the following dates:

Sunnhemp. March 23rd 1948.

Maize, Velvet Beans, Purple Top Buffel Grass, Fallow 24th—28th September, 1948.

Compost. Each plot was divided into two sub-plots and compost applied to one sub-plot at the rate of 3 short tons dry compost per acre, on 20th November, 1948.

Tobacco. All plots were treated identically as follows:

Nov. 8th, 1948. Plots hilled and fertilised at the rate of 150 lbs. per acre, 6.12.18 mixture plus 25 lbs. Agrocide 2.

Nov. 20th, 1948. Tobacco planted.

November 22nd, 1948. }
November 29th, 1948. } Tobacco re-filled.
December 3rd, 1948. }

January 17th, 1949. 150 lbs. per acre 3.12.8 mixture applied.

January 21st, 1949. First reaping.

Lay-out. Plots 10 yds. x 12 yds. approx. 1/40th acre.

Tobacco planted 3ft. x 3 ft.

Experiment laid out as 7 x 7 latin square.

Field Observations:

Season. The season proved very satisfactory for the tobacco crop.

Although there were certain periods of drought the rains came in time to prevent any serious adverse effect.

Weeds. Owing probably to the dry season weed growth was negligible and no difference between treatments was noted.

Stand. Fairly satisfactory and not affected appreciably by white grubs or false wireworms. In two plots nematode infestation slightly reduced stand.

Quality and Yield. January 24th, 1949. Tobacco following Munga and Fallow (treatment 4) showed best quality and growth combined. Tobacco following Purple Buffel Grass and Fallow was also good.

February 20th, 1949. Little difference noted at this time. Treatment 4 did not look as promising as earlier on in the season. The leaf following Maize and Sunnhemp appeared very coarse.

Results. The results on the basis of yield, price per lb. and cash value per acre are given in Table 1.

T A B L E I.

Treatment	YIELD			PRICE		VALUE			
	Actual		Adjusted to max. stand	Pence per lb.	% mean	Actual		Adjusted to max. stand	
	Lb. per acre	% mean				Lb. per acre	% mean	Lb. per acre	% mean
No. 1 ...	1,419	101.4	1,422	8.04	100.0	47 13 4	101.6	47 8 3	98.3
No. 2 ...	1,435	102.5	1,470	8.06	100.2	48 9 0	103.2	49 11 5	102.8
No. 3 ...	1,344	96.0	1,426	7.79	96.9	43 7 0	92.4	45 19 2	95.3
No. 4 ...	1,266	90.4	1,370	8.04	100.0	42 10 4	90.6	45 19 6	95.3
No. 5 ...	1,396	99.7	1,414	7.80	97.0	45 9 0	96.8	45 19 6	95.3
No. 6 ...	1,413	100.9	1,422	8.16	101.5	48 4 8	102.8	48 10 3	100.6
No. 7 ...	1,525	108.9	1,546	8.34	103.7	53 0 0	112.9	53 14 10	111.4
MEAN ..	1,400	—	1,439	8.04	—	46 18 8	—	48 4 5	—
Standard ERROR.	37	—	41	0.11	—	1 8 6	—	1 10 6	—
Sig. Diff. to 5% point ...	104	—	115	0.31	—	4 0 5	—	4 6 1	—

Significant differences to 5 % points:**Yields.** 7 better than 1, 3, 4, 5 and 6.

1, 2, 5 and 6 better than 4.

Price per pound. 6 and 7 better than 3 and 5, and almost better than 1 and 4.**Value per acre.** 7 better than 1, 2, 3, 4, 5 and 6.

1, 2 and 6 better than 3 and 4.

Similar results are shown on yields and values adjusted to uniform stand.

Discussion:

The yields from this experiment were good but on the whole quality was poor compared with leaf from Virgin land. The fallow plots gave significantly better value per acre than all other treatments and in this experiment were outstanding.

J. FIVE YEAR COURSE ROTATION

The following rotations were tested:

Treat- ment	1942— 43	1943— 44	1944— 45	1945— 46	1946— 47	1947— 48	1948— 49
No. 1	Tobacco	Tobacco	Giant Rhodes Grass	Giant Rhodes Grass	Giant Rhodes Grass	Tobacco	Tobacco
No. 2	"	"	Dhal	Dhal	Dhal	"	"
No. 3	"	"	Maize	S'hemp P.U.	Munga P.U.	"	"
No. 4	"	"	Cotton	S'hemp P.U.	Maize	"	"
No. 5	"	"	Maize	P.T.B.	P.T.B.	"	"
No. 6	"	"	Maize	Cotton	Velvet Beans C.H.	"	"
No. 7	"	"	Fallow	Fallow	Fallow	"	"

P.U. Ploughed Under.

C.H. Cut for Hay.

P.T.B. Purple Top Buffel.

Experimental Data:

Soil. Pinkish grey sand opened in 1937 since when it has carried two crops of tobacco and three seasons of Dhal prior to 1942/3 crop.

Tobacco. This was the second crop of tobacco following the rotation crops. All plots were treated identically as follows:

Nov. 9th 1948. Plots hilled and fertilised at the rate of 200 lbs. 6.12.8 mixture per acre plus 25 lbs. Agrocide 2.

Nov. 20th 1948. Tobacco planted.

Nov. 22nd 1948.

Nov. 29th 1948. } Tobacco re-filled.

Dec. 3rd 1948.

Jan. 15th 1949. 150 lbs. per acre 3.12.8 mixture applied.

Layout. Plots 9 yds. x 12 yds. approx. 1/40th acre. Tobacco planted 3 ft. x 3 ft.

Experiment laid out as 7 x 7 latin square.

Field Observations:

Stand. The stand in a number of plots were seriously affected by nematode infestation. The error was greatly increased by stand counts varying from 50 % to 96 %. There was very little loss of stand due to other pests.

Quality and Yield. Considerable differences were noted in the tobacco crop. Following three years Rhodes Grass, Maize, and two years Purple Top Buffel Grass and three years fallow the tobacco was of fairly good quality.

Early in the season however, the fallow plots were somewhat rank but this was not noticeable after the middle of February. Following three years Dhal the tobacco was dark, rank and late maturing.

Results. The results of this experiment on the basis of yield, price per pound and value per acre are given in Table II.

T A B L E II.

Treatment	YIELD					PRICE					VALUE				
	% stand	Actual		Adjusted to max. stand		Pence per lb.	% mean	Value per acre	% mean	Adjusted to max. stand	% mean	Value per acre	% mean	Adjusted to max. stand	% mean
		Lb. per acre	% mean	Lb. per acre	% mean										
No. 1 ...	83.1	1,023	99.2	1,117	101.3	8.36	101.1	35 14 9	100.6	39 2 8	102.8	39 2 8	102.8		
No. 2 ...	81.6	1,060	102.8	1,175	106.5	8.07	97.6	35 14 3	100.5	39 7 2	103.3	39 7 2	103.3		
No. 3 ...	84.6	1,056	102.4	1,127	102.2	8.41	101.7	37 0 11	104.2	39 12 11	104.1	39 12 11	104.1		
No. 4 ...	82.9	1,024	99.3	1,109	100.5	8.36	101.1	35 6 8	99.4	38 10 8	101.2	38 10 8	101.2		
No. 5 ...	90.1	1,087	105.4	1,072	97.2	8.19	99.0	37 3 4	104.6	36 14 11	96.5	36 14 11	96.5		
No. 6 ...	90.1	990	96.0	987	89.5	7.97	96.4	33 1 5	93.1	32 18 8	86.5	32 18 8	86.5		
No. 7 ...	77.3	976	94.7	1,134	102.8	8.51	102.9	34 13 10	97.6	40 4 7	105.6	40 4 7	105.6		
MEAN ..	84.4	1,031	—	1,103	—	8.27	—	35 10 9	—	38 1 8	—	38 1 8	—		
Standard ERROR	—	41	—	39	—	0.18	—	1 13 9	—	1 17 10	—	1 17 10	—		
Sig. Diff. to 5% point ...	—	116	—	109	—	0.51	—	4 15 1	—	5 2 1	—	5 2 1	—		

Significant differences to 5 % point:

Yield. 5 almost better than 7.

When calculated using six replications and excluding replication seriously infected with nematode, Treatment 5 is significantly better than 7. On adjusting yields to a uniform stand for all treatments Nos. 1, 2, 3, 4, and 7, are significantly greater than No. 6.

Price. 7 better than 6.

Value per acre. No significant difference until calculated on uniform stand when No. 1, 2, 3, 4 and 7 are better than 6.

Discussion. The high nematode infestation in this field makes observation and interpretation of results difficult. The Dhal as was to be expected from observations in the field gave a yield above average, whilst the quality of the leaf was below average. Fallow again gave the best quality.

K. FIVE-YEAR COURSE ROTATIONS.

The same rotations were tested in this experiment as in experiment J.

Experimental Data:

Soil. Red contact sand first opened in 1936. Following two crops of tobacco and one of Maize the land was allowed to revert and was re-opened in 1943.

Rotation Crops 1947/48 season. All crops were fertilised and reaped to normal practice and were ploughed under on the following dates:

Munga. 28th March, 1948.

Fallow, Giant Rhodes and Purple Top Buffel Grasses, Dahl, Maize and Velvet Beans, 22nd—26th October, 1948.

Tobacco. As experiment J.

Lay-out. Plots 10 yds. x 12 yds. approx. 1/40th acre. Tobacco planted 3 ft. x 3 ft. Experiment laid out as 7 x 7 latin square.

Field Observations:

Stand. Similar to experiment J. Nematode infestation seriously reduced stand and yield in a number of plots. Percentage stands varied from 72 % to 98 %. Again little loss due to other pests.

Quality and Yield. With the exception of the Rhodes Grass and Fallow plots all the tobacco in this field was on the rank side. This was particularly the case on the Dhal plots. The Rhodes Grass plots showed very poor growth.

Results. The results on the basis of yields, price per lb. and value per acre are summarised in Table III.

T A B L E III.

YIELD					PRICE			VALUE		
Treatment	Actual		Adjusted to max. stand		Pence per lb.	% mean	Actual		Adjusted to max. stand	
	Lb. per acre	% mean	Lb. per acre	% mean			Value per acre £ s. d.	% mean	Value per acre £ s. d.	% mean
No. 1 ...	1,049	93.0	1,104	93.6	7.47	98.7	32 10 11	34 15 9	90.4	91.9
No. 2 ...	1,149	101.9	1,244	105.4	7.61	100.5	36 7 2	38 8 6	101.0	105.7
No. 3 ...	1,173	104.0	1,258	106.6	7.63	100.8	37 7 7	40 1 3	103.8	107.4
No. 4 ...	1,226	108.7	1,268	107.5	7.57	100.0	38 12 10	39 18 11	107.3	107.1
No. 5 ...	1,011	89.6	1,011	85.7	7.37	97.4	31 0 6	31 1 4	86.2	83.2
No. 6 ...	1,126	99.8	1,164	98.6	7.60	100.4	35 19 1	37 3 8	99.8	99.7
No. 7 ...	1,163	103.1	1,209	102.5	7.76	102.5	37 11 11	38 16 4	104.4	104.1
MEAN ..	1,128	—	1,180	—	7.57	—	36 2 0	37 5 11	—	—
Standard Error	54	—	57	—	0.11	—	1 14 7	1 18 8	—	—
Sig. Diff. to 5% point ..	153	—	161	—	0.30	—	4 16 5	5 9 1	—	—

Significant differences to 5 % point.

Yield. 4 better than 1 and 5.

3 better than 5.

7 almost better than 5.

Price per pound. 7 better than 5.

Value per acre. 4 better than 1 and 5.

2, 3, 6, and 7 better than 5.

7 better than 1.

3 almost better than 1.

Discussion:

Fallow plots in all rotation experiments this season have consistently given the best quality leaf. Treatments 1 and 5 in this experiment have given the worst results and it is interesting to note that both include a grass cover.

From observations this season the low rainfall (23.44") has accentuated differences between rotations which include legumes and others. The rank growth following Dahl is probably due to very little loss of residual nitrogen by leaching. On the other hand in the process of decomposition of the Rhodes Grass in treatment No. 1, the bacteria responsible for this action have tended to monopolise the nitrogen available. This is necessary to them in order to balance the Carbon: Nitrogen ratio in the final product of decomposition, namely humus.

Hence only a very small amount has been available for the tobacco crop, giving limited growth. This point will have to be investigated further. It has been suggested that the initial application of fertiliser should contain a higher percentage of nitrogen when a large amount of dead material is ploughed under. Time of ploughing must also be an important factor.

ROTATIONS UNDER INTERMEDIATE CROPS.

Grass. The grass rotation laid down in the 1946-47 season (see Annual Reports for 1947 and 1948) was continued. It is due for a crop of test tobacco in the 1949-50 season. Another similar rotation was laid down on land which had carried two crops of tobacco.

The following grasses were included in the rotation:

- (1) *Urochloa mosambicensis* (Sabi grass) planted at spacing 18" x 18" on 24/11/48.
- (2) *Digitaria milaniana* (Milanji grass) planted at spacing 3' x 3' on 23/11/48.
- (3) *Urochloa bolbodes* (Gonya grass) planted at spacing 18" x 18" on 23 and 24/11/48.
- (4) *Sorghum arundinaceum* (Rhod. Sudan grass) planted at spacing 3' x 18" + 20 lbs. per acre of seed sown in drills 3' apart on 24 and 25/11/48.
- (5) *Cenchrus ciliaris* (African foxtail) planted at spacing 3' x 18" on 25/11/48.

- (6) Weed fallow.
- (7) *Chloris gayana* (Giant Rh. Grass) planted at spacing 3' x 18" on 23/11/48.
- (8) *Digitaria pensii* (Woolly finger) planted at spacing 3' x 3' on 23 and 24/11/48.
- (9) *Panicum makarikari* (Makarikari) planted at spacing 3' x 3' on 24/1/49.

The grasses were planted in 10 yd. x 24 yd. plots and replicated four times. All the grasses established themselves well with the exception of the Gonya grass which, although refilled twice was very poor.

It is intended to divide each plot into two sub-plots with applications of fertiliser to grass as follows:

(1) Nil.

(2) One annual dressing Phosphate and Potash plus dressings of Nitrogen as required.

Nursery Plots.

The following plots of grasses were laid down for trial:

- (1) *Cenchrus ciliaris* (African foxtail) two strains.
- (2) Star grass No. 2.
- (3) Star grass No. 4.
- (4) *Setaria kuzungula* (African Timothy grass).
- (5) *Acroceras macrum*.
- (6) *Paspalum urvilli* (Upright paspalum).
- (7) *Pennisetum purpureum* (Napier Fodder).
- (8) *Digitaria swazilandensis*.
- (9) (Kikuyu grass).
- (10) *Digitarius malmaniesoog*.
- (11) *Paspalum notatum*.
- (12) *Hemarthria fasciculata* (Swamp couch).
- (13) (Woolly finger).

Crops.

This season it has been decided to discontinue the 3 and 5 year course rotations in favour of rotations based on a grass ley. J & K lands have therefore been turned over to work on nematode, whilst H. land (light grey sand) will be brought into the new programme.

NEW PROGRAMME.

This will be commenced in the 1949-50 season with the following rotations which will be tried on different soils:

- (1) 4, 5 and 6 years rotation to compare 2, 3 and 4 years grass ley or weed fallow as a rotation for tobacco.
- (2) 7 years rotation, tobacco, tobacco, maize, green crop, 3 years grass ley.

- (3) **Grass rotations** as already laid down.
- (4) **Time of ploughing** of grass leys for tobacco.
- (5) **Manurial treatment** of tobacco following a grass ley.

B. SEED BED EXPERIMENTS.

'Soluble' Humus.

A proprietary product was obtained from the United Kingdom which was alleged to be the soluble portion of humus and claimed to give increased growth and disease resistance to plants when applied in solution.

Only a small percentage of the compound was soluble in water and its application to seed beds at various strengths gave no obvious effect.

BENZENE HEXACHLORIDE DAMAGE.

Distortion of tobacco seedlings after applications of compounds containing Benzene Hexachloride was reported to this station from a number of sources towards the end of 1948 and a small trial was laid down to confirm these reports.

Four dusts were tested at the following rates of application on:

- (a) very young seedlings.
- (b) 'Tickey' size seedlings.

Dusts 1 and 2. At rates 2.8; 8.4; and 16.8 Grams per square yard.

Dust No. 3. In solution $2\frac{1}{2}$ ozs. in 4 galls. water at rates 200, 600, and 1800 ccs. per square yard.

Dust No. 4. At rates 5.6, 16.8, and 33.6 grams per square yard.

Dust No. 4. In solution $2\frac{1}{2}$ ozs. in 4 galls. of water at rates 200, 600, and 1800 ccs. per square yard.

The dust contained either Benzene Hexachloride or D.D.T. in the following percentages:

Dust 1. 0.5 % Gammexane.

Dust 2. 0.3 % Gammexane.

Dust 3. 50 % D.D.T. Wettable powder.

Dust 4. 0.3 % Gammexane and 3 % D.D.T.

All B.H.C. compounds at the heavier dressings resulted in inhibition of growth and distortion at both stages in growth of seedlings.

Smaller dressings of B.H.C. compounds gave very little damage.

In all cases the plants rapidly grew away from the damage but it must be noted that the applications were only made once. Continuous applications of sprays containing B.H.C. may lead to more serious distortion and inhibition of growth.

The one D.D.T. compound tested, even at heavy dressings, only resulted in a slight mottling of the leaves.

PRESOAKED TOBACCO SEED.

Treatments.

- (1) Seed sown 29/9/48 as normal practice.
- (2) Seed previously soaked for two days, sown by watering can, on 29/9/48.

Results.

(Treatment 1) plants observed 6/10/48.
Plants sprayed ('Tickey' size) 27/10/48.

(Treatment 2) Plants observed 4/10/48.
Plants sprayed ('Tickey' size) 20/10/48.

Observations.

Seedlings from pre-soaked seed were observed two days before control but on the whole seemed to be about a week ahead in growth.

It is possible that pre-soaking of seed will be a good practice where the water supply is short, as in this case the length of time of plants in the seed-beds was reduced by one week.

More work however, is necessary on this method before it can safely be adopted.

RATE OF APPLICATION OF FERTILISER.

Fertiliser (6.12.48 mixture) was applied to three plots as follows:

- (1) 3.5 ozs. per sq. yd.
- (2) 7.0 ozs. per sq. yd.
- (3) 10.5 ozs. per sq. yd.

The seed-beds were sited on black vlel soil in fairly good heart. Good germination and growth resulted from treatments 1 and 2. As was to be expected Treatment 2 was slightly darker in colour.

Treatment 3 however, showed poor growth and germination and it was obvious that the high application of fertiliser had reached the level of toxicity.

III. Cultural and Variety Trials

SPACING TRIALS.

Two spacing experiments were carried out this season using the identical spacing treatments employed last season namely, 3' x 1' 6"; 3' x 2'; 3' x 3'; 4' x 1'; 4' x 1' 6" and 4' x 2'. One experiment was located on a light grey sand soil and the other on a rather heavier reddish sandy loam.

EXPERIMENT R.

A newly cleared land of light grey sandy soil was used for this trial. The plots were 12 x 24 yds. and each main plot was divided into three sub-plots of 12 x 8 yds. and given differential nitrogen applications namely 24, 36 and 48 lbs. per acre respectively. On the 22nd November the plots were pre-fertilised at the rate of 150 lbs. per acre for the 3' x 3' spacing; the same fertiliser cup being used for the closer spacings, the plants therefore received the same amount of fertiliser per plant for each spacing. Planting took place on the 29th November and further fertiliser applications were made on the 17th and the 31st January. The station strain of Bonanza was used as the test plant.

The following table shows the mean yield per acre, price per pound, and value per acre. The prices and values are based on standard prices for standard grades used in previous years for easy comparison. These prices are, of course, only about 1/6th of present day prices.

TABLE I. Yield, Prices and Values. Spacing Experiment R.

Treatment	% stand	YIELD per acre		PRICE per lb.		VALUE per acre			% mean
		Lb.	% mean	Pence	% mean	£	s.	d.	
1. 3'x 1' 6" ...	84.1	1,813	113.3	9.27	100.9	70	0	10	114.6
2. 3'x 2' ...	91.8	1,641	102.6	9.03	98.3	61	15	3	101.0
3. 3'x 3' ...	96.7	1,390	86.9	9.64	105.0	55	13	5	91.1
4. 4'x 1' ...	75.8	1,684	105.3	9.13	99.4	64	1	6	104.8
5. 4'x 1' 6" ...	86.4	1,623	101.5	8.99	97.9	60	13	7	99.3
6. 4'x 2' ...	93.2	1,445	90.3	9.04	98.4	54	6	3	88.9

F. test significant for yield and value.

	Yield	Price	Value
Mean of Treatments	1,599	9.18	£61/1/10
S.E.	2.41 %	1.96 %	2.62 %
S.D.	112 lbs.	0.52d.	£4/13/5
S.D. mean	7.02 %	5.70 %	7.63 %

SUMMARY OF SIGNIFICANT DIFFERENCES.

Yield: 1 better than 2, 3, 4, 5 and 6.

2, 4, 5 better than 3 and 6.

Price: No significant difference.

Value: 1 better than 2, 3, 4, 5 and 6.

2, 4, 5 better than 3 and 6.

Increasing the nitrogen level over the 24 lbs. per acre level on a per plant basis had no significant effect.

Experiment S.

This experiment was located on a newly cleared land consisting of a reddish sandy loam. Plot size, treatment and dates of planting and fertiliser application were identical to the experiment on the grey sand.

The following table shows the mean yield per acre, price per pound and value per acre.

TABLE II.
Yield, Prices and Values. Spacing Experiment S.

Treatment	% stand	YIELD per acre		PRICE per lb.		VALUE per acre		
		Lb.	% mean	Pence	% mean	£	s.	d.
1. 3' x 1'6" ...	84.8	1,966	113.3	9.22	100.3	75	17	7
2. 3' x 2'	87.6	1,801	103.8	9.25	100.6	69	7	5
3. 3' x 3'	92.6	1,523	87.7	8.94	97.2	56	13	7
4. 4' x 1'	81.8	1,876	108.1	9.21	100.2	71	19	11
5. 4' x 1'6" ...	84.3	1,735	100.0	9.37	101.9	67	16	2
6. 4' x 2'	89.4	1,513	87.2	9.16	99.6	58	4	4

F. test significant for yield and value.

	Yield	Price	Value
Mean of Treatments	1735 lbs.	9.19d.	£66/13/2
Standard Error	3.38 %	1.66 %	3.75 %
Sig. diff., 5%	171 lbs.	0.44d.	£7/5/7
Sig. diff. % of mean	9.85 %	4.78 %	10.92 %

Summary of Significant Differences.

Yield: 1 better than 3, 5 and 6.

2, 4 and 5 better than 3 and 6.

Price: No significant difference.

Value: 1 better than 3, 5 and 6.

2, 4 and 5 better than 3 and 6.

In the following two tables a comparison is made between the results obtained on the two different soils.

TABLE III.

Comparison of Yield per acre with different Spacing on two Soils.

Spacing	Area per Plant sq. ft.	No: Plants % St'dard	Yield per acre		Yield per acre	
			Grey	Sand	Sandy	Loam
			lbs.	% St'dard	lb.	% St'dard
3'x 3'	9	100.0	1,390	100.0	1,523	100.0
4'x 2'	8	112.5	1,445	103.9	1,513	99.3
3'x 2'	6	150.0	1,641	118.0	1,801	118.2
4'x 1' 6''	6	150.0	1,623	116.7	1,735	114.9
3'x 1' 6''	4½	200.0	1,813	130.4	1,966	129.0
4'x 1'	4	225.0	1,684	121.1	1,876	123.1

TABLE IV.

Value per acre with Different Spacing on Two Soils.

Spacing	Area per Plant sq. ft.	Value per acre Grey Sand		Value per acre Sandy Loam	
		£	% St'dard.	£	% St'dard.
3'x 3'	9	55.6	100.0	56.6	100.0
4'x 2'	8	54.3	97.6	58.2	102.8
3'x 2'	6	61.7	110.9	69.3	122.4
4'x 1' 6''	6	60.6	108.9	67.8	119.7
3'x 1' 6''	4½	70.0	125.8	75.8	113.9
4'x 1'	4	64.0	115.1	71.9	127.0

Discussion.

Price per pound was not significantly different this season with any of the different spacings on either of the two soils. As regards yields the results were remarkably similar for the two soils; thus closing the spacing from 3' x 3' to 3' x 2' resulted in a yield increase of approximately 18% for a 50% increase in the number of plants. Closing the spacing to 3' x 1' 6'' or doubling the number of plants used as compared with the standard 3' x 3' spacing resulted in a 30% increase in yield. Value per acre showed rather greater increases with closer spacing on the sandy loam soil than on the light grey sand and this is in line with previous findings on this station.

The closer spacings this season were not accompanied by a lower average price per pound and increasing the amount of nitrogen above 24 lbs. per acre did not affect either yield or quality. This result is most probably due to the exceptionally small amount of rainfall during the growing period.

These results have however, in the main, confirmed previous findings in that there remains little doubt that the spacing can be profitably closed down to 3' 6" x 2' or 3' x 2' to give an increased yield without any serious loss in quality.

For commercial plantings a spacing of about 3' 6" x 2' or 3' x 2' is probably optimal on the above types of soil taking into consideration the greater number of plants used and the extra fertiliser required for still closer spacing.

VARIETY TRIALS.

A summary of results of variety trials on the station to date was given in last year's report and therefore need not be repeated here.

Variety trials this season were confined mainly to testing proved strains of the popular varieties and two promising crosses raised on the station. Three trials were carried out on different soil types.

RESULTS OF EXPERIMENTS.

Trial A.

This was carried out on newly cleared land and the soil was a light grey sand.

The varieties used were:

A.1. Jamaica Wrapper, A.2. Willow Leaf, A.3. White Stem Orinoco, A.4. Yellow Mammoth, A.5. Bonanza, A.6. C.7.46 Jamaica Wrapper x Bonanza and A.7. C.10.46 Jamaica Wrapper x Bonanza.

The land was fertilised and hilled on the 30th Nov. with 150 lbs. of Virginia A mixture 6.12.18. The experiment was planted on the 2nd December. The initial stand was very good. Re-filling took place on the 30th December, and the 15th January.

Growth was good and high yields of good quality tobacco were obtained.

The results are summarised in Table V.

TABLE V.

Yields, Prices and Values in Variety Trial A.

Variety	% Stand	Yields per acre		Price per lb.		Value per acre			
		Lb.	% mean	Pence	% mean	£	s.	d.	% mean
1. J. Wrap	94	1,280	100.0	8.3	91.2	44	6	0	100.7
2. Willow Leaf	94	1,080	93.2	9.3	102.2	41	16	0	93.8
3. White Stem Orinoco	92	1,080	93.2	9.4	103.3	42	6	0	96.1
4. Yellow Mammoth	95	1,070	92.2	9.0	98.9	40	2	0	91.1
5. Bonanza	98	1,160	100.0	9.7	106.6	46	18	0	106.6
6. C.7.	93	1,330	114.6	8.9	97.8	49	6	0	112.0
7. C.10.	94	1,110	95.7	8.8	96.7	40	14	0	92.5

"Z" Test significant for Yield, Price and Value.

	Yields	Price	Value
Mean of Varieties	1,160 lb.	9.1d.	£44/0/0
Standard Error	2.8%	6.7%	7.0%
Significant Diff. 5%	65.7 lb.	1.2d.	£5/18/0
Significant Diff. % of mean.	5.7%	13.1%	13.4%

Summary of Significant Differences.

Yield: Nos. 1 and 6 better than 2, 3, 4, 5 and 7.

No. 5 better than 2, 3 and 4.

Prices: No. 5 better than 1.

Value: No. 6 better than 2, 3, 4 and 7.

No. 5 better than 4 and 7.

The outstanding result of this experiment was the high yielding capacity of the cross between Jamaica Wrapper and Bonanza No. C.7 on this light grey sand soil this season. The station strain of Bonanza produced the highest quality leaf.

Trial B.

This was situated on newly cleared land of reddish loamy sand. The soil was slightly heavier than that used for Trial A.

The land was planted on the 2nd December, re-filled on the 30th December and the 15th January. It was pre-fertilised with 150 lbs. of Virginia A, and a further 150 lbs. of Virginia A was applied on the 3rd February.

Growth was good and heavy yields of good quality tobacco were obtained.

The results are summarised in Table VI.

TABLE VI.
Yields, Prices and Values in Variety Trial B.

Variety	% stand	Lb.	% mean	Pence	% mean	£ s. d.	% mean
1. J. Wrap	87	1,220	106.1	8.7	96.7	44 4 0	102.5
2. Willow Leaf	83	1,010	87.8	9.1	101.1	38 6 0	88.9
3. W. Stem Orinoco	82	1,170	101.7	8.5	94.4	41 8 0	96.0
4. Yellow Mammoth	82	1,160	100.9	9.6	106.7	46 8 0	107.6
5. Bonanza	84	1,180	102.6	9.5	105.5	46 14 0	108.3
6. C.7.46.	85	1,170	101.7	9.4	104.4	46 16 0	106.3
7. C.10.46	83	1,200	104.3	9.3	103.3	46 10 0	107.9
8. Gold Dollar	89	1,100	95.6	8.9	98.9	40 16 0	94.7
9. Harr. Special	97	1,240	107.8	7.8	86.7	40 6 0	93.5
10. Gold Dollar	96	1,140	99.1	8.8	97.7	41 16 0	97.0
11. Oxford 26.	78	1,030	89.6	9.1	101.1	39 0 0	90.5

"Z" test not significant for yield, price or value.

Trial C.

This trial was situated on old third year land with the object of studying if a differential varietal effect was noticeable under these conditions. The land was fertilised with 150 lbs. per acre Virginia A mixture and hilled on the 30th November and planted on the 2nd December. Re-filing was carried out on the 30th December and on the 15th January.

The same seven varieties were used as in Trial A.

The results obtained are shown in the following Table. (VII).

TABLE VII.

Yields, Prices and Values in Variety Trial C.

		Yield per acre		Price per lb.		Value per acre	
Variety	% stand	Lb.	% mean	Pence	% mean	£. s. d.	% mean
1. J. Wrap	88	870	106.1	6.3	98.4	22 16 0	104.1
2. Willow Leaf	82	790	96.3	6.1	95.3	20 2 0	91.8
3. W. Stem Orinoco	73	730	89.0	6.2	96.9	18 16 0	85.8
4. Yellow Mammoth	82	730	89.0	6.8	106.2	20 14 0	94.6
5. Bonanza	87	880	107.3	6.8	106.2	24 18 0	113.7
6. C.7.46.	80	930	113.4	6.0	93.7	23 4 0	105.9
7. C.10.46	77	800	97.6	6.2	96.9	20 14 0	94.5

"Z" test significant for yield, price and value.

Summary of Significant Differences.**Yield:** No. 6 better than 2, 3 and 4.

No. 5 better than 3 and 4.

Price: Nos. 4 and 5 better than 1, 2, 3, 6 and 7.

No. 1 better than 6.

Value: No. 5 better than 2, 3, 4 and 7.

Nos. 1 and 6 better than 3.

The outstanding results of this experiment was the high yielding capacity of the cross between Bonanza and Jamaica Wrapper bred on this station. It gave however, slightly lower quality leaf than most of the other varieties.

It must be realised however that little can be said from the results of a single season's variety experiments and that results must be collected over a number of years before the potentialities of any particular set of environmental conditions can be judged. A summary of ten years varietal trials was given in last year's report.

IV. Nutrition of Tobacco

Compost Experiments.

The results of previous experiments were again confirmed. Thus the response to compost as measured by the yield and quality of tobacco depends primarily on the condition of the soil; old lands and lands which have been under rotational crops almost invariably respond well to compost dressings, whereas with newly cleared land response is usually not noticeable or very slight.

Pot Cultures.

In the effort to learn more about the nutrition of tobacco in the Colony both in relation to quality and to disease resistance it has become necessary to commence more precise experimentation than has been carried out previously. The effect of a deficiency of any of the major nutrient elements, is being studied using sand and sand plus vermiculite pot cultures fed with nutrient solutions of known composition. Symptoms of deficiency of nitrogen, potassium and phosphorus were produced successfully in preliminary trials and this technique should help considerably in the diagnosis of deficiencies in commercial plantings under our particular climatic complex.

Another line of investigation that is being pursued by means of pot cultures has as its object the fixing of appropriate fertiliser applications for the many different soil types on which tobacco is now being grown. It is obviously impossible to run fertiliser experiments in all areas and on all different soil types; but by using pot fertiliser trials with the level of each particular nutrient being varied at a constant level of the others it should be possible to fix appropriate levels for different soils within fairly close limits. The results obtained can then be supplemented and checked by field fertiliser trials in selected areas.

V. Plant Pathology

Introductory Note. — Report for 1948/49 in Plant Pathology.

The series of experiments in the following report are in large part a continuation of experiments initiated by the Chief Botanist and Plant Pathologist and the Senior Plant Pathologist some three to four years ago. This applies in particular to the experiments on field spraying.

The method of copper estimation on sprayed tobacco leaf was modified from Large (1948) by the Senior Plant Pathologist and the Soil Chemist.

The research programme was drawn up by the Chief Botanist and Plant Pathologist and the Senior Plant Pathologist in collaboration with the Senior Tobacco Research Officer.

A. Priming Experiment — Trelawney.

The precise way in which frog-eye (*Cercospora nicotianae*) infects a land is not at present completely understood. The disease can infect isolated lands as shown by Norval (1945) so that it would appear that primary infection is from some source external to the land.

It is of considerable interest from the point of view of control to know (1) whether frog-eye is definitely wind-borne and that primary infection comes from outside the land and (2) whether secondary infection is the result of disease setting in on unprimed plants and spreading to primed within a land.

The following experiment was laid down at Trelawney to test these points. The experiment consisted of a third year land of some 4 acres. Three 1/40 acre plots were marked out at each corner as shown in the diagram. These were left unprimed while the bulk of the land was primed twice.



Planting, fertilising etc.

Variety—Bonanza.

Planted—20/11/48.

Fertilised—15/11/48 — 150 lbs. Virginia A per acre.

8/1/49 — 100 lbs. Virginia A per acre.

Primed — 20/12/48.
3/1/49.

Sampling.

Whole plant samples were taken at random in the land and their positions marked. Leaves were stripped from the stems and placed between sheets of newspaper on the following dates: 12/1/49, 31/1/49, 7/2/49, 21/2/49. No barn spot type lesions developed in the papers after 5 days. During the period the crop was in the land, the incidence of frog-eye was extremely small. Sampling of unprimed plots and incubation of the leaves in paper for 5 days failed to produce any spot.

Spore Trapping.

Spore traps consisting of 3" x 1" microscope slides coated with glycerine jelly, supported horizontally under shields in the land, were set up in conjunction with the sampling. Six traps were placed across the land horizontally and six diagonally.

The first exposures were made for a day at a time, but as no spores were found on the slides after this period, the time of exposure was increased to two and then three days.

Slides were examined under the microscope at a magnification of about 250 diameters with low light intensity. This shows up any *Cercospora* spores, which are hyaline.

Results.

As none of the samples taken produced any spot, it was concluded that either the number of spores in the atmosphere was very low or that conditions were not right for infection. That the former was the case was shown by the results from spore trapping. At no time were more than 10 spores caught in all 12 traps. Spores appeared at random in the traps; there was no evidence to suggest that there were more spores in the vicinity of unprimed plots. As no disease appeared in these plots and taking into consideration the random distribution of spores in the traps, it would seem that primary infection by frog-eye is the result of outside infection. The nature of these sources of infection is not yet known, but it seems likely that they take the form of tobacco debris, tobacco volunteers, other growing tobacco or alternative hosts.

That the spore traps were giving a fair indication of the spore load in the atmosphere was shown by a steady increase in the number of *Alternaria* spores caught between 7/2/49 and 18/2/49 which coincided with a small outbreak of this disease first noticed on 7/2/49.

In view of the indeterminate results obtained, it will be necessary to repeat the experiment during the 1949/50 season.

B. Priming Experiment — Karoi.

The value of priming in field practice is still a matter of dispute. It is necessary to be quite clear as to what priming means. Priming consists in the removal of lower leaves of the plant at an early stage, before these decline and become subject to leaf-spotting diseases such as frog-eye. The actual removal and subsequent treatment of these leaves seems to be a matter of personal opinion. Some farmers take these as a first reaping and cure them, others remove them and destroy

them, while others bury them by ridging up over them, and allow them to decompose in the soil.

The practice of priming seems to be fairly general when one considers the foregoing. There are however, a number of growers who leave the lower leaves to decline on the plant, thus exposing their crops to a potential source of infection.

The actual value to be gained from priming can be resolved into two parts.

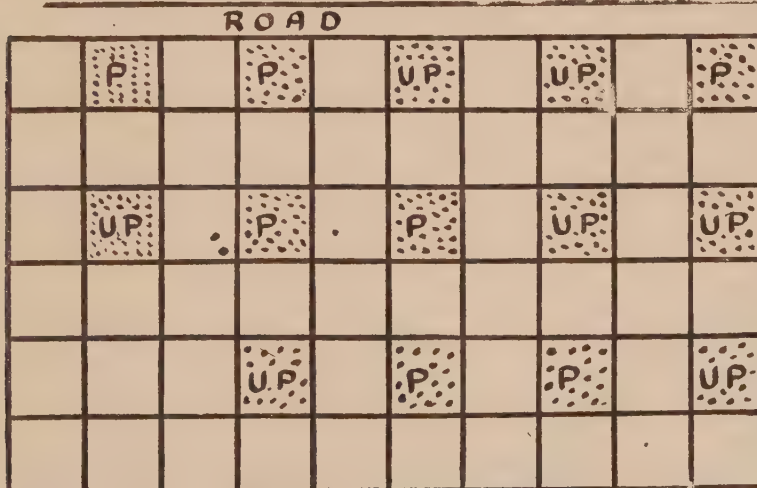
- (1) The gain in good quality clean leaf.
- (2) The enhanced price resulting from the sale of such leaf.

The weight of tobacco reaped from primed plants need not necessarily be lower than that from unprimed plants. An increased supply of nutrients becomes available to a smaller number of leaves in primed plants thus increasing their weight. The question at issue is, however, whether the price per lb. is higher in primed than unprimed tobacco due to less spotting.

The present experiment was designed to study the effect of priming on (a) disease incidence, (b) yield and (c) quality in terms of price per lb.

Experimental Details.

The experiment consisted of a randomised block design for two treatments, primed and unprimed, replicated 7 times, on 2nd year land. Plots were 1/20 acre in extent and each experimental plot was surrounded by two guard rows of primed tobacco. Experimental plots were also completely separated from one another by guard plots of primed tobacco (diagram).* Previous experiments have been complicated by the junction of primed and unprimed tobacco. The presence of unprimed tobacco in the immediate vicinity of primed must increase the possibility of infection of primed tobacco from the diseased leaves on the unprimed. Guard plots reduce the possibility of this occurring.



**UNSHADED. PLOTS
ALL PRIMED.**

* Experimental design by Dr. H. L. Pearse, Senior Tob, Research Officer.

Planting, Fertilising, etc.

Variety — Bonanza.

Planted — 24/12/48.

Fertilised — 1/12/48 — 100 lbs. Virginia B.

9/2/49 — 100 lbs. Virginia B.

Primed — 7/2/49.

18/2/49.

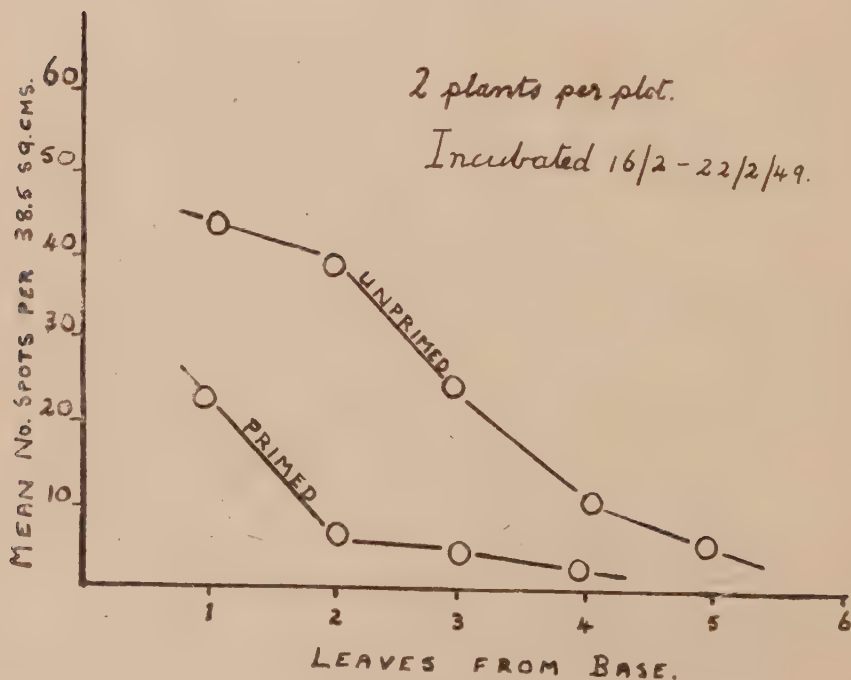
3/3/49.

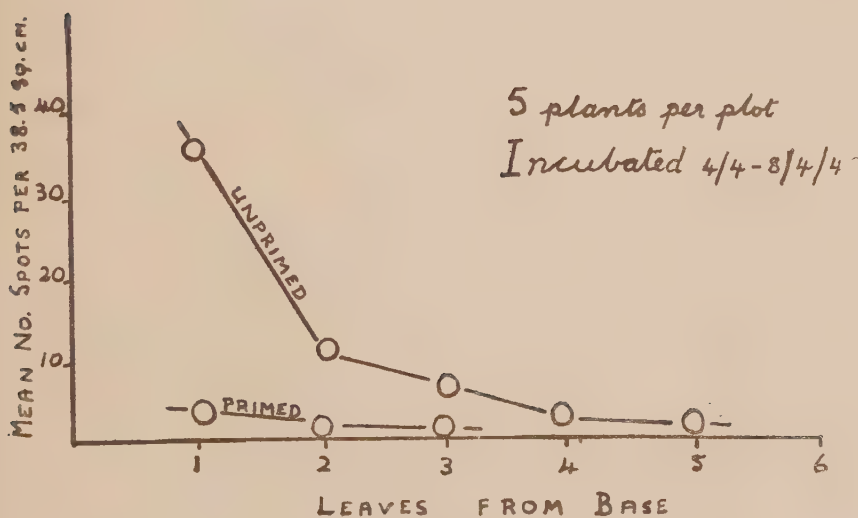
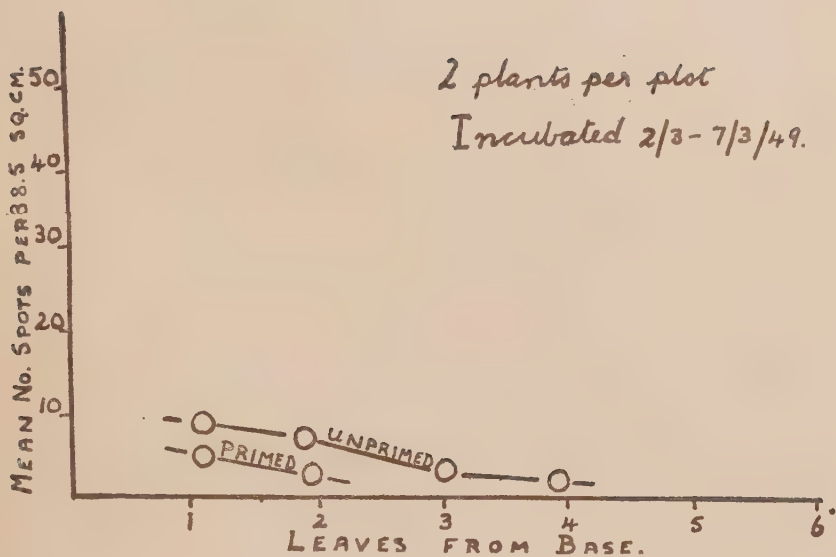
Results.

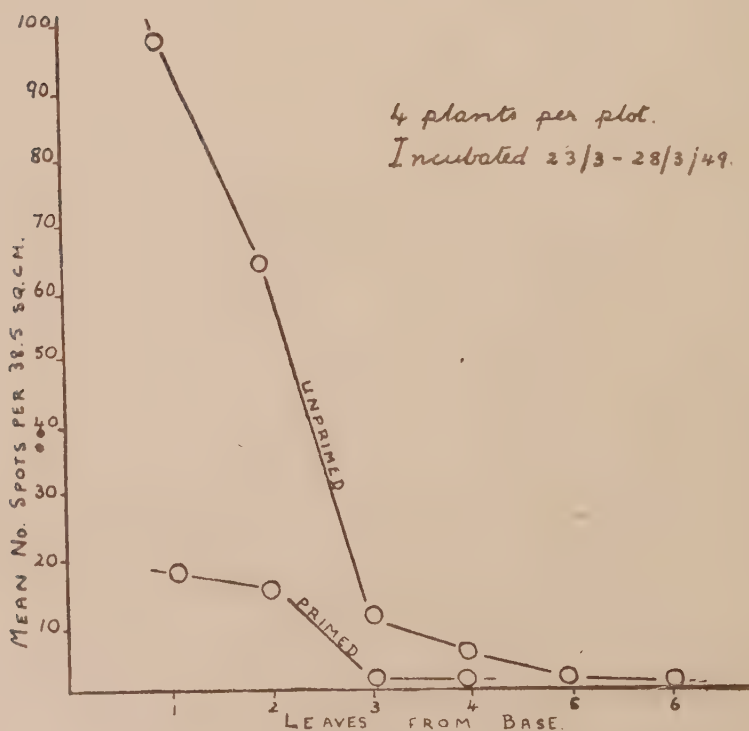
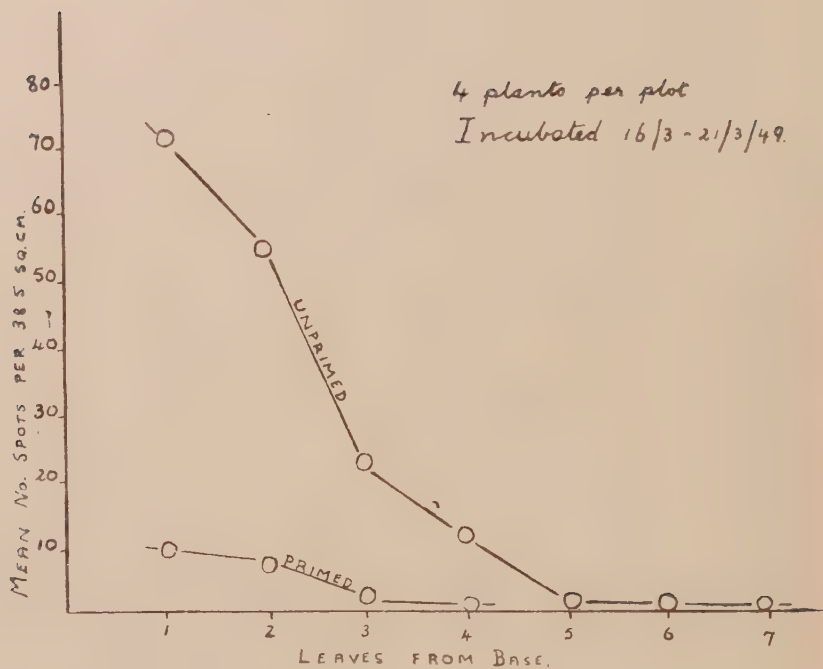
(1)—Field Sampling.

Samples consisting of 2—5 plants per plot were taken at intervals during the growing period. Unprimed plants were stripped of the first three leaves and these were discarded to make leaf numbers comparable with primed plants. Remaining leaves were placed between sheets of paper and incubated 5 days. Any frog-eye spots or incipient lesions develop barn type spotting within this period. The average number of spots in an arbitrary circle of 38.5 sq. cms. was calculated by counting spots within the circle at three points on each leaf.

Results are shown graphically below:







Two points show clearly from the graphs.

- (a) The total amount of spotting on unprimed is greater than that on primed tobacco. This is true of all 5 sets of samples taken during the season.
- (b) Spotting occurs on the plants one to two leaves higher on unprimed than primed tobacco.

There did not appear to be any correlation between the amount of spotting and rainfall for the week previous to sampling.

(2) Graded Weights.

Graded weights gave the following information for primed and unprimed tobacco, % barn-spotted leaf, % brights, % shorts, % heavy graded leaf, weight per acre, weight per acre corrected for stand, value per acre, and price per lb. Tables of these results are shown below together with the standard error, and significant differences for means are included where appropriate.

Table 1. Percentage Barn-spotted leaf.

Primed Plot No.	% spot	Unprimed Plot No.	% spot
124	6.39	125	59.12
139	11.91	126	41.85
151	28.33	137	22.06
152	1.46	138	59.09
163	11.10	150	12.65
164	14.44	165	39.11
176	4.69	177	35.74
Mean	11.19	Mean	39.51

Standard Error: 7.35.

Significant differences: 16.01 (5%).
22.45 (1%)

Table II. Percentage brights (mean).

Primed	Unprimed
21.47%	16.12%

Standard Error: 6.11.

Table III. Percentage shorts (mean).

Primed	Unprimed
5.82%	5.38%

Standard Error: 1.75.

Table IV. Percentage heavy leaf (mean).

Primed	Unprimed
5.47%	7.68%

Standard Error: 3.73.

Table V. Weight per acre (mean).

Primed	Unprimed
469.1 lb.	540.8 lb.

Standard Error: 57.87.

Table VI. Weight per acre corrected to 100 % stand (mean).

Primed	Unprimed
690.7 lb.	745.7 lb.

Standard Error: 90.83.

Table VII. Value per acre (mean).

Primed	Unprimed
£17/5/9	£17/19/9

Table VIII. Price per lb. (mean).

Primed	Unprimed
6.03 pence	5.70 pence

Standard Error: 0.39.

The only significant difference found in the experiment was for percentage spot. There was a greater percentage of barn-spotted leaf from unprimed than from primed tobacco, significant at the 1 % point.

Although differences exist for weight per acre and price per lb. these are not significant.

It would appear that in this particular experiment good control of barn spot is obtained by priming, but no financial gain accrued from the practice.

Though a number of leaves have been lost during priming there was no significant reduction in yield, presumably due to increase in weight of the remaining leaves.

In a wet year assuming a much greater percentage of spot in the crop it would appear that priming would be well worth while, since a higher price would result from unspotted leaf without a significant reduction in yield.

C. Spray Trials.

1. Trelawney Trial.

This spray trial consisted of a Latin square arrangement for 5 treatments. Each treatment plot was divided into 3, 1/40 acre sub-plots for time of spraying. The arrangement will be clear from a consideration of the diagram. The land used had had previously 3 crops of tobacco and had then been fallow for 1 year.

Planting, Fertilising, etc.

Variety — Bonanza.

Planted — 21/1/49.

Fertilised — 26/11/48 150 lbs. Virginia A.

5/2/49 150 lbs. Virginia A.

28/2/49 150 lbs. Virginia A.

Spraying.

Sprays used in the trial were as follows:

- (1) Ky-Bordeaux, 4—4—50 strength.
- (2) Rainfast Blitox, 4 lbs. per 100 galls.
- (3) Boots copper oxychloride white oil emulsion. 1 pint per 10 galls.
- (4) Dithane Z—78, 3 lbs. per 100 galls. plus trace Lissapol as spreader.
- (5) Control unsprayed.

All sprays were applied at the rate of 60 galls. per acre (1½ galls. per sub-plot). Time intervals between spray applications, (sub-plots) were 1 week, 10 days and 14 days. Spraying was commenced on the 25th January, 1949, and continued at the appropriate time-intervals till 8 March, 1949.

Sampling.

Plants were sampled from the plots at intervals during the growing period right up till the time of reaping. These were examined for spot development by the technique used in the priming experiments. At no time did any spot develop in the papers although several samplings were made before reaping. Accordingly, it was decided to estimate the amount of spotted tobacco in the best manner possible under the circumstances.

A small amount of frog-eye spotting occurred in the land, so that it was possible to count the number of spotted plants per plot, and to estimate the percentage.

Virtually no spot occurred in the barns, hence no records were kept of graded weights from plots.

Lay-out — Spray Trial — Trelawney.

1	2	3	4	5
A x y z	B x y z	C x y z	D x y z	E x y z
B	E	D	A	C
C	A	B	E	D
D	C	E	B	A
E	D	A	C	B

Timing: x : 7 days.
y : 10 days.
z : 14 days.

Sprays: A : Ky-Bordeaux.
B : Rainfast Blitox.
C : Copper Oxychloride.
D : Dithane Z-78.
E : Control unsprayed.

Results.

Mean No. of spotted plants for each treatment irrespective of time of spraying is given in Table 1. while spray-time interactions are given in Table II.

Table 1. Means — Latin square. (Totals 3 sub-plots).

Ky-Bordeaux	Blitox	Copper oxychloride	Dithane Z-78	Control
121.48	191.06	184.45	187.60	204.62

S.E. 23.68.

Significant differences: 51.59 (5%).
: 72.34 (1%).

Table II. Latin Square re-arranged as randomised block.
Time — Spray Interaction — % Spotted plants.

A x	A y	A z	B x	B y	B z	C x	C y	C z	D x	D y	D z	E x	E y	E z
25.45	36.19	63.79	59.00	67.10	64.95	53.87	62.47	68.09	54.54	61.98	67.07	51.40	71.73	81.48

Mean Control 68.20.

S.E. : 9.60.

Significant differences: 19.20 (5%).

25.54 (1%).

The Latin Square results place the sprays in order of efficiency as follows:—

Ky-Bordeaux better than control at 1% point.

Ky-Bordeaux better than Blitox, copper oxychloride, and Dithane at 5% point.

No significant difference exists between means of control, Blitox, copper oxychloride and Dithane.

Table II. shows spray-time interactions means.

Significant differences exist between Bordeaux at 1 week and 10 days and the mean control at the 1% point, also between Bordeaux at 1 week and 10 days and Bordeaux at 2 weeks, (1% point). The other three sprays were not significantly better than the controls at any time interval.

An interesting result was the appearance of a significant difference between the three controls, (Ex & Ey 5%, Ex & Ez 1%). This would appear to be due to the depressant effect of the spray on spot development where controls border sprayed plots. The amount of spot was greatest in the controls bordered top and bottom by fortnightly-sprayed plots and least in those bordered by weekly-sprayed plots, the 10-day plots occupying an intermediate position. Correspondingly most spot developed in fortnightly sprayed plots and least in weekly-sprayed plots for all the sprays though only Bordeaux mixture showed a significant difference.

The benefits to be derived from spraying appear not to be confined to the tobacco actually sprayed but also to neighbouring tobacco that might have become infected had the crop not been sprayed.

II. Spray Retention Studies.

One of the most important attributes of a spray if it is to be successful is ability to stick and to remain on the leaf even during wet periods.

Plants in the Trelawney spray trial were sampled for copper retention analysis to determine the percentage copper remaining after given periods.

Sampling consisted of taking 50 leaves at random per plot each at approximately the same insertion on the plant. Samples were taken (1) immediately after spraying when the spray had dried (controls were sampled at this time too), (2) immediately before the following application of spray i.e. these samples were taken either at the end of 1 week, 10 days or 14 days. Two plots were sampled for each spray. The lots of 50 leaves were made into packs and discs of diam. 17.5 mm. were cut from the bundles at the tips and centres giving two cylinders of 50 discs each for each plot.

The method of copper estimation is given by Large et.al. (1946). The method was modified by ashing the leaf samples before digestion with nitric acid and making the colorimetric estimation in alkaline solution.

Results.

Copper was determined in terms of .01 mgms. per 120 sq. cm. (total area of 50 discs). A small amount of copper was in each case

recorded for the unsprayed leaves; this was subtracted from the readings obtained for sprayed leaves. The tables below show percentage retention of copper for tips and centres of leaves taken after each spray application interval. The test is used to determine significance of results.

Table I. Weekly Spraying — Rainfall 1.03 in.

Mean % Retention Cu.

	<i>Tip.</i>	<i>Centre.</i>
A. Ky-bordeaux	77.6	82.4
B. Rainfast Blitox	67.9	46.8
C. Copper oxychloride-white oil emulsion.	67.6	83.0

<i>S.E. diff. means:</i>	<i>S.E. diff. means:</i>
A-B,14.20	A-B,15.24
B-C,13.10	B-C,17.30
C-A, 9.10	C-A,22.62
<i>t. diff. means:</i>	<i>t. diff. means:</i>
A-B: 0.68	A-B: 2.46
B-C: 0.02	B-C: 2.09
C-A: 1.09	C-A: 0.26

$$t_2 = 4.30$$

Table II. 10-day spraying — Rainfall 1.03 in.

Mean % Retention Cu.

	<i>Tip.</i>	<i>Centre.</i>
A. Ky-Bordeaux	88.2	(101.0)
B. Rainfast Blitox	11.6	10.5
C. Copper oxychloride-white oil emulsion	27.2	56.4

<i>S.E. diff. means:</i>	<i>S.E. diff. means:</i>
A-B,12.62	A-B,41.14
B-C, 9.59	B-C,13.73
C-A,14.57	C-A,43.31
<i>t. diff. means:</i>	<i>t. diff. means:</i>
A-B: 5.27*	A-B: 1.77
B-C: 1.62	B-C: 3.34
C-A: 4.18	C-A: 1.02

$$t_2 = 4.30$$

Table III. 14-day spraying — Rainfall 0.59 in.
Mean % Retention Cu.

	<i>Tip.</i>	<i>Centre.</i>
A. Ky-Bordeaux	42.6	63.6
B. Rainfast Blitox	16.8	18.7
C. Copper oxychloride-white oil emulsion	45.4	47.2

<i>S.E. diff. means:</i>	<i>S.E. diff. means:</i>
A-B,5.16	A-B, 6.21
B-C, 9.15	B-C, 6.14
C-A,10.45	C-A, 4.07
<i>t. diff. means:</i>	<i>t. diff. means:</i>
A-B: 5.00*	A-B: 7.23
B-C: 3.12	B-C: 4.64
C-A: 0.27	C-A: 4.02

$$t_2 = 4.30$$

* Significant at 5% point.

Discussion.

Bordeaux showed a higher percentage retention than any other spray, but this was only significant on centres and tips of fortnightly sprayed leaves and tips of 10-day sprayed leaves. There was also a significant difference between Blitox and copper oxychloride at centres of fortnightly sprayed leaves.

There was a high standard error in all the determinations due, (1) to insufficient replications, (2) uneven application of spray. This reduced the possibility of significant differences.

Very little difference overall was found between tips and centres. Spray dried very rapidly in the land so that run-off was negligible; this led to a slightly higher concentration of spray at the centre than at the tips.

The samplings for fortnightly sprayed plants were taken at a different period from the week and 10-day sprayed plants due to handling difficulties. After a fortnight the quantity of spray retained had decreased appreciably in all cases, but Bordeaux was retained to a greater extent than the other two sprays. Blitox was retained to a greater degree at the centre than copper oxychloride. It is interesting to note that spray may be lost due to other causes than rain. Only 0.59 in. fell during the fortnight concerned here; the percentage retention however is considerably lower than that for the week and 10-day sprayings when 1.03 in. of rain fell. This is probably due to the growth of new foliage over this period, dew, wind, etc.

Karoi-Trial.

The spray trial at Karoi consisted of the following treatments:

- A₁ 4-4-50 Bordeaux — 7 day interval spraying.
- A₂ 4-4-50 Bordeaux — 14 day interval spraying
- B₁ Perenox 4 lbs. per 100 galls. — 7 day interval spraying.
- B₂ Perenox 4 lbs. per 100 galls. — 14 day interval spraying.
- C₁ Rainfall Blitox 4 lbs./100 galls. — 7 day interval spraying.
- C₂ Rainfall Blitox 4 lbs./100 galls. — 14 day interval spraying.
- D₁ Copper lime dust 30 lbs./acre — 7 day interval.
- D₂ Copper lime dust 30 lbs./acre — 14 day interval.
- E Control — untreated.

The experiment was set out as a randomised block design with 5 replications of each treatment.

Results.

Virtually no spot was recorded after several samplings of the trial and treatment by the technique previously described. No spot of any consequence appeared in the land.

It is interesting to note again here as in the Trelawney trial that the spray and dust treatments appeared to exert a generally depressing effect on the incidence of spot in the controls. The almost complete absence of spot after sampling and incubation of the leaves in papers was in marked contrast to the adjoining priming trial where a fair amount of spot developed.

A very small percentage of barn spot appeared during curing and in view of this replicates of treatments were bulked during grading.

The percentage spotted leaf per plot is shown in Table I.

Table I. % spotted leaf per 5 treatment plots.

<i>Treatment</i>	<i>% spot</i>
A₁	3.89
A₂	5.42
B₁	4.89
B₂	4.38
C₁	5.68
C₂	2.42
D₁	5.31
D₂	6.17
E	7.97

Figures show a larger percentage spot in controls than in treated plots. In view of the data being bulked a statistical analysis of the result is not possible. It seems doubtful however, that there is any significance in the figures.

References.

- (1) Annual Report of the Chief Botanist and Plant Pathologist for year ended 31st December, 1948. Sum. R.A.J. July-August, 1949.
- (2) Large, E.C. et. al.
"Annals Applied Biology"
33.1. 54-63. 1946.
- (3) Norval, I. P. Trelawney Tobacco Research Station. Annual Report 1945. p. 32.

VI. Soil Pests

A. ROOT KNOT NEMATODE.

Research work carried out on the root knot nematode, *Heterodera marioni*, (Cornu) Goodey, may be classified under the following headings:—

- (1) Influence of soil fumigation with D.D. on the yield, quality and nematode infestation of tobacco in lands.
- (2) Study of the degree of resistance exhibited by two eelworm resistant varieties.
- (3) Study of the effectiveness of D.D. in the control and eradication of nematodes in tobacco seed-beds.
- (4) Experiments to test the efficacy of soil fumigants with special reference to D.D.
- (5) Preliminary study of the effect of certain varieties of Cotton upon the nematode population in the soil.

(1) SOIL FUMIGATION WITH D.D. IN LANDS.

D.D. has been intensively tested out in many parts of the world for the destruction of soil borne plant parasites, particularly nematodes. It is a dark liquid composed of unsaturated chlorinated compounds, namely a mixture of dichloropropane and dichloropropene.

The land used in this particular experiment had grown a crop of tobacco during the 1947-48 season. The incidence of eelworm was recorded at the end of the 1947-48 season, and the figures given to the writer at the beginning of the present season.

Throughout all nematode work the findings were classified using, the 0, 1, 2, 3, system, the basis of which is, 0 — free from infection; 1 — light infection (under 25% of the roots galled); 2 — medium infection (25%—50% of the roots galled); 3 — heavy infection (over 50% of the roots galled).

D.D. was applied at planting stations (3ft. by 3ft.) at the following doseages — 4 cc's, 6 cc's, 8 cc's, 10 cc's, 12 cc's, control plots being left untreated. In addition a "time interval" application of 8 cc's was carried out. It was intended to plant 14 days after fumigation, and the "time interval" application 7 days before transplanting.

There were 5 replications and the variety used was Bonanza.

Unfortunately no suitable conditions for transplanting came about until 5 weeks after fumigation.

At the time of fumigation the Soil Temperature at a depth of 12 in. was 71.6°F. and the soil moisture was 5.42%.

Fumigation was carried out under ideal conditions i.e. conditions suitable for transplanting seedlings. Immediately after fumigation, Virginia "A" fertiliser mixture was applied at the rate of 150 lbs. per acre. The soil was then hilled up and made ready for planting.

Refilling to an extent of 5% was carried out within 10 days of planting.

A further 50 lbs. fertiliser was applied 6 weeks after planting.

Observations made when the crop was growing can be summarised as follows:—

- (a) The greater the quantity of D.D. applied the less re-filling was required, evidence that some other soil pests were probably killed or deterred from attack by D.D.
- (b) Some control plots did not show symptoms of nematode attack proving that infestation was not uniform throughout the land and for such an experiment as this it is necessary to have land with a uniformly heavy infestation.
- (c) Those plots which received lighter treatments of D.D. matured and ripened a little sooner than those which received heavier dosages.
For reasons not fully understood D.D. had the effect of imparting some vigour to the plants. It has been stated by Kincaid R.R. & Volk G.M. that fumigation prolongs the retention of ammonia nitrogen in the soil, which probably explains the phenomena.
- (d) D.D. did not cause any malformation of the leaves and the plants growing in the heavily treated plots did not appear any different in uniformity from those growing on plots which received a smaller quantity of D.D.

Lifting and examination of all the roots commenced on 20.5.49 and was continued on the following three days. The total number of root systems examined was 3,283.

Due to the lack of uniformity of infestation by nematodes the results obtained were not conclusive.

Effect of D.D. on yield and quality.

There was no significant difference in either the yield or the quality of the tobacco from any of the treatments. There were indications that the time elapsing between fumigation taking place and the seedlings being planted is an important factor. The stand was better and the yield, though not significantly, was slightly greater.

This experiment is to be repeated during the 1949-50 season on a piece of land which is known to be heavily and uniformly infested by *Heterodera marioni*.

(2) STUDY OF THE DEGREE OF RESISTANCE EXHIBITED BY TWO EELWORM RESISTANT VARIETIES.

This experiment comprising 24 plots was laid down in the same piece of land as the experiment described previously. Uniformity of nematode infection was again lacking with the result that the figures obtained could not give a true and correct valuation of the merits of the two varieties under test.

Varieties used were known as Variety No. 1 and Variety No. 2 with Bonanza as control.

Each plot was 12 yards by 10 yards and the spacing 3 ft. x 3 ft. There were 8 replications giving 24 plots in all.

Pre-fertilisation at the rate of 100 lbs. of Standard Tobacco Mixture per acre, took place on 7.12.48. All plots were planted on 1.1.49 and re-filling to an extent of 50 per cent took place on 14.1.49. No further re-filling was necessary. On 21.2.49 fertiliser was applied at the rate of 100 lbs. per acre of Standard Mixture.

Soil was heavier than sand veld type and resembled to some extent a contact type of soil.

Observations made during the growing period indicated:

- (a) No noticeable difference in the vigour of the three varieties.
- (b) Leaves of varieties 1 and 2 seemed to have a slightly thinner leaf when compared with Bonanza.
- (c) Varieties 1 and 2 in the early stages tended to form leaves somewhat similar in shape to "Turkish" leaves.

The first of 5 reapings took place on 24.3.49.

The lifting and examination of all root systems started on 23.6.49 and was continued on the following two days.

From examination of the root systems it was evident that infection by *Hererodera marioni* was very patchy and in one control plot there was no evidence of the presence of nematode. However, those plants of all 3 varieties which were infected were similar regarding the shape and the size of the galls.

Varieties 1 and 2 were not resistant to nematode attack but were tolerant, this was also shown in a subsidiary small scale test carried out on land with a heavy and uniform infestation. Though Varieties 1 and 2 exhibited more vigour and resistance to attack the galling of their root systems did not differ from Bonanza.

Yield and Quality.

There was no significant difference in either the yield or quality of any of the three varieties.

In Variety 1 there was a greater percentage of light grade leaf than in the case of Variety 2 and Bonanza.

Further work on these varieties in addition to Variety 402 and Oxford 26 has been planned and will be carried out on heavily infected nematode soil during the 1949-50 season.

(3) STUDY OF THE EFFECTIVENESS OF D.D. IN THE CONTROL AND ERADICATION OF NEMATODE IN TOBACCO SEEDBEDS.

Two experiments of a similar nature were laid down and carried through, one on Ziroto Farm, Trelawney, and the other on Dundrennin Farm, Sinoia.

Each seedbed was 3 ft. x 4 ft. enclosed by bricks and separated from the next by a path 1½ feet wide. D.D. was injected into the soil

at one foot intervals and to a depth of nine inches. Both experiments were identical in every detail except that the land on Dundrennin Farm was more heavily infected.

Treatments.

2cc's, 4cc's, 6cc's, 8cc's, of D.D. per square foot. Control beds being left untreated. There were 5 replications giving 25 beds in all.

The beds were treated using a hand injector when the soil was in a damp condition, thus preventing rapid evaporation of D.D.

Moisture content was 5.0% at the time of fumigation and the soil temperature at the same stage was 73.4°F.

Fourteen days after fumigation took place all beds were sown with Bonanza seed.

Observations made during the following weeks were as follows:—

- (a) Germination in all beds was even and satisfactory.
- (b) From approximately the tenth day after germination there was a noticeable dying off of seedlings in the untreated beds.
- (c) One week later there were very few seedlings remaining in the control beds.
- (d) At the same period the seedlings in those beds receiving 2cc's and 4cc's of D.D. per square foot were spaced unevenly over the beds.
- (e) In those beds receiveing 6cc's and 8cc's of D.D. per square foot the seedlings showed no visible symptoms of nematode attack and were growing satisfactorily.
- (f) Eight weeks after sowing, the seedlings were at the stage suitable for transplanting.

At this stage they were carefully lifted leaving the outer 6 in. of plants in each bed. The reason for this being that if there was any invasion of the nematode population from the untreated paths these outer plants would have acted as a trap.

The root systems were examined and the results from Dundrennin Farm are in Table 1, and those from Ziroto Farm in Table 2.

TABLE 1.

Treatment	I N F E C T I O N			
	0	1	2	3
Control	2.0%	14.7%	55.2%	28.1%
2cc's/sq. ft.	9.5%	31.9%	28.3%	30.3%
4cc's/sq. ft.	42.9%	32.0%	19.3%	5.8%
6cc's/sq. ft.	76.8%	20.6%	2.6%	—
8cc's/sq. ft.	100.0%	—	—	—

TABLE 2.

Treatment	I N F E C T I O N			
	0	1	2	3
Control	18.2%	46.8%	15.6%	19.4%
2cc's/sq. ft.	36.4%	40.9%	15.1%	7.6%
1cc's/sq. ft.	43.0%	33.9%	18.0%	5.1%
3cc's/sq. ft.	70.8%	29.2%	—	—
8cc's/sq. ft.	100.0%	—	—	—

Conclusions.

Treatments of less than 6cc's of D.D. per square foot do not eradicate nematode, the minimum dosage lies between 6cc's and 8cc's per square foot.

To find out the actual quantity required, experiments are planned for the 1949-50 season in which the dosages will range from 6cc's to 8cc's.

Other fumigants with Methyl bromide and Ethylene dibromide as their active ingredients are being tested out during the coming season.

(4) EXPERIMENTS TO TEST THE EFFICACY OF SOIL FUMIGANTS WITH SPECIAL REFERENCE TO D.D.

The method used is a reliable one and is most useful, and in fact essential, when comparing several soil fumigants under natural conditions.

Nematode inoculum was prepared by the following method: The root systems of heavily infected tobacco plants were minced and the resulting mass mixed with infected soil, the proportions being 3 parts minced root material to 1 part infected soil.

A small quantity of the inoculum was enclosed in fine cheese cloth bags which were then buried in the soil at known distances from a point where D.D. was injected.

The land used was well cultivated and was a typical soil for the cultivation of tobacco.

Narrow trenches were dug to the required depths i.e. 6, 9, 15, 21, and 24 inches. The trenches were made long enough to allow the bags to be placed at distances of 3, 6, 9, 12, 18 and 24 inches from the middle point where a stake was inserted. It was at this point that the D.D. was injected. Ten bags of inoculum were prepared for each trench and were divided into two groups of 5 bags each. One group of 5 placed to the right, and the other group of 5 to the left of the stake, at the above distances. The trenches were then filled in, care being taken to firm down the soil thoroughly.

The soil temperature was taken at a point 8 inches away from the stake and at right angles to the trench. A sample for the determination of soil moisture was taken from the same place.

Soil temperature — 56.8°F.

Soil moisture — 9.15%.

The stakes were then taken out and D.D. injected to a depth of 8 in. at the following dosages:—4cc's, 6cc's, 8cc's, 10cc's, and 12cc's.

Fourteen days after fumigation took place the bags of inoculum were removed from the soil and the inoculum was transferred to pots of sterilised soil and a test plant, tobacco in this case, planted. The tobacco seedlings were allowed to grow for 6 weeks and were then removed and examined. The results were tabulated using the 0, 1, 2, 3 system.

Soil moisture at the end of the experiment was 8.25%. Rainfall was recorded from the time fumigation took place and the bags being removed from the soil — a total of 4.23 in.

Fully tabulated results show the lethal effect of D.D. when acting upon the inoculum at various depths.

Table 1. Inoculum at a depth of 6 ins.

Doseages in cc's	Lateral Range in inches						Lateral Range in inches					
	24	18	12	9	6	3	3	6	9	12	18	24
4	3	3	3	2	0	0	0	1	2	3	2	3
6	3	3	2	0	0	0	0	0	2	3	2	2
8	3	3	1	0	0	0	0	0	0	2	2	2
10	2	2	1	0	0	0	0	0	0	1	3	2
12	3	2	1	0	0	0	0	0	0	1	3	3

Table 2. Inoculum at a depth of 9 ins.

Doseages in cc's	Lateral Range in inches						Lateral Range in inches					
	24	18	12	9	6	3	3	6	9	12	18	24
4	3	2	2	1	0	0	0	0	1	1	3	3
6	3	2	2	0	0	0	0	0	1	1	3	3
8	3	2	1	0	0	0	0	0	0	1	3	3
10	3	2	0	0	0	0	0	0	0	0	1	3
12	2	3	0	0	0	0	0	0	0	1	2	3

Table 3. Inoculum at a depth of 15 ins.

Doseages in cc's	Lateral Range in inches						Lateral Range in inches					
	24	18	12	9	6	3	3	6	9	12	18	24
4	3	1	2	0	0	0	0	0	0	2	2	2
6	3	3	1	0	0	0	0	0	0	2	2	3
8	3	3	2	0	0	0	0	0	0	0	2	3
10	2	1	0	0	0	0	0	0	0	0	1	2
12	2	2	0	0	0	0	0	0	0	0	2	2

Table 4. Inoculum at a depth of 21 ins.

Doseages in cc's	Lateral Range in inches						Lateral Range in inches					
	24	18	12	9	6	3	3	6	9	12	18	24
4	2	2	1	1	0	0	0	0	1	1	3	2
6	3	3	1	1	0	0	0	0	1	1	2	3
8	3	3	1	0	0	0	0	0	0	1	3	3
10	3	2	2	0	0	0	0	0	0	1	1	3
12	3	2	1	0	0	0	0	0	0	0	2	3

Table 5. Inoculum at a depth of 24 ins.

Doseages in cc's	Lateral Range in inches						Lateral Range in inches					
	24	18	12	9	6	3	3	6	9	12	18	24
4	2	2	1	1	0	0	0	0	2	1	2	1
6	3	2	1	1	0	0	0	0	1	1	2	3
8	3	2	2	1	0	0	0	0	1	1	2	3
10	3	3	1	1	0	0	0	0	1	2	2	2
12	1	2	1	0	0	0	0	0	0	0	2	2

Discussion.

Doseages of 4cc's and 6cc's of D.D. did not appear to be consistently effective. In the case of the higher quantities the results obtained from using 8cc's indicated that this was the most effective and economical. Any improvement obtained by using 10cc's and 12cc's was not in relation to the extra cost involved.

A dosage of 8cc's gave a lethal range of 9 ins. which means that by using this quantity when fumigating seed beds the spacing between injection points can be increased from 12 to 18 inches without impairing the efficiency of fumigation. In no case will fumigation be effective more than 12 inches away from the point of injection.

In the case of fumigation of lands it is not economical to inject at 18 inch intervals and assuming we use a spacing of $3\frac{1}{2}$ feet by 2 feet and a dosage of 8cc's the quantity required for one acre would be 11 gallons which would cost £7.11.3.

The quantity of D.D. required per acre in the case of seedbeds using an 8cc's dosage and injecting at 18 inch intervals would be a little over 51 gallons at a cost of approximately £35/2/6.

During the 1949-50 season it is intended to incorporate three other soil fumigants in an experiment such as this and so to determine the efficacy of each when under identical conditions.

(5) EFFECT OF CERTAIN VARIETIES OF COTTON UPON THE NEMATODE POPULATION IN THE SOIL.

In the 1946 Annual Report of the Trelawney Tobacco Research Station it was suggested by Mitchell that the rootlets of certain varieties of Cotton may act as a trap crop, becoming infected with eelworm but being shed from the plant before the nematode has time to reproduce.

In order to verify or confute this statement preliminary work was started near the end of this season.

From pot tests with varieties 9L34, 12204, 12405 the results gave an indication that the above statement was substantially correct and further intensive study would be justified.

If it can be proved that certain varieties of cotton do act in this way, it may have far reaching effects and may possibly be the answer to the problem of lands with a high nematode population by reducing it to a level where a satisfactory tobacco crop could be grown.

Full scale field and pot experiments have been planned for the 1949-50 season. These entail replicated plots using 4 cotton varieties with fallow plots as control. All plots will be planted in tobacco during the following season at the end of which all root systems will be examined and classified according to intensity of infection.

B. USE OF GAMMEXANE AGAINST SOIL PESTS.

Last seasons experiments proved that gammexane dust applied immediately before planting or several weeks before is effective either applied broadcast or as local dressings around the plant for combating loss of plants due to attacks of white grubs and false wireworms. It was also shown that gammexane may also be used effectively to treat hills where plants are missing, before refilling. At the same time it was pointed out that gammexane treatment is expensive and it was thought that the most economic method of application might be the use of light local dressings at planting followed by treatment of refilling stations. This year's experiments were therefore planned to explore further this method of application.

Experimental Details.

Two identical experiments were carried out on two different types of soil: one on a light grey sandy soil and the other on a reddish sandy loam. A dust containing 0.5 per cent. gammexane was used throughout and the initial application was made by mixing with the soil in the hill about a fortnight before planting. Treatments were as follows: (1) No gammexane before planting. Re-fills treated at rate of 25 lbs. per acre. (2) 8 lbs. per acre at planting. Refills 25 lbs per acre. (3) 8lbs. per acre at planting. Refills 50 lbs. per acre. (4) 15 lbs. per acre at planting. Refills 25 lbs. per acre. (5) Control. No gammexane either before planting or re-filling. The results from both experiments are summarised in the following Table 1.

TABLE 1.
GAMMEXANE TRIALS.
O AND P 1948-49.

	Gray Sandy Soil					Reddish Sandy Loam				
	0	8	8	15	0	0	8	8	15	0
Rate at Planting 0.5% dust. lb. per acre.										
Rate at Refilling.	25	25	50	25	0	25	25	50	25	0
% Loss before refilling from:										
White grubs and Wire-worms	9.56	6.94	6.17	5.40	10.64	7.77	6.38	5.55	3.75	7.36
Unidentified	1.23	0.46	0.77	0.46	0.92	1.94	1.52	0.97	0.97	1.80
All causes except crickets	10.79	7.40	6.94	5.86	11.56	9.71	7.80	6.52	4.72	9.16
Crickets	1.69	1.08	0.61	0.61	0.92	1.11	0.97	0.13	0.41	1.11
% stand at maturity	93.5	96.7	95.5	95.8	90.2	96.1	95.2	98.1	98.4	94.0

Significant Differences:
2, 3 and 4 better than 5.

Significant Differences:
3 and 4 better than 1, 2 and 5.

Unfortunately from the experimental point of view insect attack was very slight this season and differences between treatments are not therefore as large as in previous seasons.

On the light grey sand soil treatments 2, 3 and 4 are better than no treatment, but differences between treatments did not reach the level of significance. The saving in percentage stand for any of these treatments was between 5 and 6 per cent. Where only the refills were treated control was not so effective.

On the reddish sandy loam soil treatments 3 and 4 were significantly better than no treatment and also better than treatments 1 and 2. The saving in stand from treatments 3 and 4 was in this case about 4 per cent.

Treatment 4 consisting of an initial treatment of 15lbs. per acre reduces the initial loss of stand by about 50 per cent.

The refilling treatment of 25lbs. per acre where no initial treatment had been given roughly halved the loss of refills. With the other treatments where an initial treatment had already been applied the effect of the refilling treatment is not clear owing probably to the very small amount of refilling required.

From the practical point of view, however, it would appear that an initial treatment of planting stations with gammexane 0.5 per cent. dust mixed with the fertiliser to give a rate of application of 20lbs. per acre as measured for a 3ft. x 3ft. spacing followed by a treatment of refilling stations at the same rate, would give adequate control of losses due to white grubs and wireworms.

The treatment of individual planting stations incorporating the gammexane dust with the fertiliser seems preferable to a broadcast application. It has the advantage of using much less dust, which is a considerable economy, without any loss of effectiveness during the season of application. The residual effect the following season of broadcast application appears to be about one fifth of the dose applied.

High Dosages.

Tobacco was grown on land receiving dosages of 0.5 per cent. gammexane at the rate of 50, 100, 200 and 500lbs. per acre. There was no apparent effect on yield or on selling value from these excessive applications. Cigarettes were made up from the tobacco and smoking tests of the comparatively freshly-cured leaf did not reveal any detectable taint of gammexane.

VII. Physiology

The Possible Use of Plant Hormones for the Control of Suckering

It is the usual practice in tobacco cultivation to remove the tops of the plants when the flower spike is beginning to expand, in order to encourage the growth of the topmost leaves. After the removal of the tops, however, the buds present in the axil of each leaf, start very active growth and the desired objective is not achieved unless these growths or suckers, as they are commonly called, are periodically removed. This operation has normally to be carried out at least once a week and therefore requires a considerable labour force.

This reaction of the plant to the removal of the actively growing terminal bud is not confined to tobacco but is in fact common to most plants. Thus, gardeners often make use of this fact in producing bushy plants, by pinching out the growing points of the shoots. Botanists had long been conscious of this fact and the earliest explanations put forward were of a nutritional nature; thus it was thought that the actively growing terminal bud acted as a sink for available nutrients so that the axillary buds were starved of the necessary materials for growth. In 1925, however, the Oxford botanist, Snow, produced very strong evidence to show that a special inhibiting substance of a hormonal nature was involved. Later, in 1934, after the discovery and isolation of the plant hormones, Skoog & Thiman (1934), were able to replace the action of the terminal bud in suppressing growth of buds below it, by the application of a pure chemical substance to the cut end of the stalk. The exact mechanism by which inhibition is brought about is still a matter of some controversy; but the important point to note here is that it is possible to replace the inhibiting action of the tops by the application of pure chemical substances to the cut or broken end of the stalk.

It is rather surprising that an attempt to make use of this discovery in tobacco cultivation was not made earlier but it is possibly due to the fact that a plant hormone expert interested in tobacco production is perhaps a rare occurrence. The earliest recorded work was carried out by Steinberg (1947), who carried out trials under glass-house conditions. Plant hormones were applied in dust carriers or in solutions to the wound left after topping and a marked retardation in sucker growth was noted.

At Trelawney the following chemicals received preliminary trials, alpha naphthalene acetic acid, B-naphthoxyacetic acid, 2-4-dichlorophenoxy acetic acid and methyl alpha naphthalene acetate. The chemicals were dissolved in lanoline by heating and the resulting pastes were applied to the end of the stalk after topping at the rate of about 1 gram of the paste per plant.

B-naphthoxyacetic acid appeared to have very little inhibiting effect: in fact tended rather to stimulate sucker growth from preliminary trials and was therefore discarded from further trial.

Alpha naphthalene acetic acid was tested at several different concentrations and appeared to exert its greatest effect on growth of the suckers from the base of the plant up to the top three or four suckers; but its action was much less satisfactory on the top suckers. 2-4-dichloro-

phenoxy acetic acid in contrast exerted its greatest effect on the top-most suckers. As a result of these observations a mixture containing both alpha naphthalene acetic acid, and 2-4-dichlorophenoxy acetic acid was prepared and at present the most promising mixture is that containing 2 per cent. 2-4-dichlorophenoxy acetic acid and 5 per cent. alpha naphthalene acetic acid.

A replicated experiment was carried out comparing the effect of some of the most promising mixtures with normal hand suckering. There was no significant difference in the yields from any of the different treatments and the most important point was that the use of the hormones had no detrimental effect on the yield or on the quality of the leaf. The best time of application of the hormones to obtain maximum suppression of sucker growth has still to be worked out but from preliminary observations it would appear important to apply the hormones before any appreciable sucker activity has occurred. Further work will be directed towards attempting to discover more efficient mixtures, determining the optimum time of application and the best method of application.

References.

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VIII. Engineering Research

Chimney Research.

From calculations it became obvious that the normal wood furnace chimney of 9in. x 9in. section was too small for a coal furnace and that a size of 14½in. square was the minimum necessary for efficiency.

In a study of burnt-out initial flues it became apparent that this condition is caused by:—

- (1) Lack of sufficient combustion chamber space.
- (2) Lack of sufficient velocity in the initial stages of flue system.

Point (1) above is demonstrated by a comparison of the Gundry type wood and coal furnaces, in both cases the combustion chamber is the same size; the wood furnace is very successful but the coal furnace is relatively uneconomical and the initial length of flue pipe is usually burnt out each year. This also applies to many other types of furnaces in general use. The T.R.B. furnace with a properly designed combustion chamber in accordance with Board of Trade practice does not suffer from this disability.

Point (2). The usual layout is to combine the two side flue pipes into one pipe of the same diameter to form a "Tee" at the entrance to the chimney; this "Tee" creates a blockage and it is better to provide a double exit by building a chamber each side of the furnace onto the barn wall, and leading the ends of the flue pipe each into its own chamber, thus providing an adequate expansion chamber, for the flue gases. In effect fitting of the "Tee" piece is postponed in the installation until a single exit is capable of dealing with the volume of gas generated. This method of change is illustrated in Drawing No. 53.

The combination of larger combustion chambers and double exit for flue gases has proved efficient and has been recommended to all farmers who have to change from wood to coal. On one farm in the Trelawney district the barns had stayed at 125 degrees and it was impossible to raise the temperature. These barns were fitted with furnaces hitherto run on wood fuel. The farmer changed to coal without altering his chimneys (9in. x 9in.); he was advised to revert to wood fuel and this procedure solved the difficulty.

On a second farm similar trouble could not be cured in the same way as there was no wood available. Fourteen and a half inch flue pipes were purchased and substituted for the 9in. brick chimneys and a successful "cure" resulted.

Bondings.

A furnace with fire bricks bonded in dagga, must be opened each year because the dagga is eroded by the hot furnace gases. It is considered that this action will eventually so weaken the construction that the side walls will spring and let the arch down. It is not generally realised that dagga does not combine with fire bricks to give a strong structure as do the proprietary bondings. If dagga is used the furnace side walls should either be buttressed, or an angle iron frame fitted as is

advocated in Drawing 5 of the T.R.B. furnace. The recommended bonding "Searset" has had to be deleted from the construction sheets.

Searset.

"Searset" in the original form is one of the strongest fire brick bondings ever made; the bricks will often break elsewhere than at the bond when dismantling is undertaken. "Searset" is an American product and the dollar situation makes its importation difficult. It is manufactured in South Africa but lately several drums purchased by growers have been examined and found to be lacking in some essential factor and so to avoid failures, its recommendation has been withdrawn until the full essentials are again available.

Pyruma.

No. 1 grade has proved an efficient bond. It is practically the same price as "Searset" and may be relied upon to provide a lasting bond. No. 2 Pyruma, a patching compound has also proved efficient.

No. 3 Pyruma, is a powder to be mixed as required with water. It should be a more economical bonding as it is only necessary to mix the amount required. All these bondings cost about 42s. per cwt.

Wankie "Grog".

This company asked that a trial of the material they manufacture for their own furnaces be carried out. This material appears satisfactory in every way. The cost is £3.15.0 a ton and 5 cwt. is more than sufficient for one furnace. It is thus only one quarter of the cost of the proprietary bondings hitherto in use. The company requires the buyer to furnish his own bags. The bonding is in powder form and it is only necessary to mix sufficient as needed. The material requires a little clean water and is mixed to the consistency of cream. It will keep indefinitely in the bags as long as it is kept dry.

Wankie Fire Bricks.

The standard fire brick is difficult to cut and it is impossible to design a furnace without a cut brick. Owing to the ease with which they can be cut, Vereeniging bricks have been recommended in the past. The Wankie company have brought out an alumina brick AL 803, which cuts just as easily as an ordinary brick and costs the same as a standard. When ordering bricks for furnaces it is recommended that 20 of these AL 803's should be ordered; they can always be used in place of standard if they have not been cut.

Furnaces.

Two new coal furnaces have been evolved; both using the T.R.B. patent principles. The new T.R.B. called the Midget, is the same as the prototype; but the bricks are built standing on the 3in. edge instead of the 4½in. This results in a 50 per cent. saving in bricks and the furnace is lower and smaller. Over a series of runs this furnace averaged 1,500lbs. of coal per barn. It must be bonded in Pyruma and this puts the cost of £7 for bonding and £7.10.0 for bricks. It is intended now to bond with the new Wankie "grog" and try out this furnace next season.

The second furnace is an outside coal furnace incorporating bottom vent heating. This furnace needs only 330 standard fire bricks. In order to cut down the cost of furnaces, a T.R.B. furnace was constructed wholly in fire bricks bonded with dagga. It was thoroughly tried out

during the stoker training classes and proved efficient. It has since completed the season satisfactorily.

The arch was bonded with angle irons running along and supporting the cap bricks, one angle each side. At each end of the angle iron an half inch bar, threaded at each end was passed through the angles, with a nut, **screwed hand tight initially** on the end of the $\frac{1}{2}$ in. bar; the wide walls were thus freed of the spreading action of the arch.

The side walls of this furnace, after about the equivalent of two season's running are bowed and it was apparent from examination that the action of the furnace gases had eroded the dagga from between the bricks, leaving the furnace in a dangerous condition. In all cases where dagga has been used to bond fire bricks, it is strongly recommended that the arch be lifted and Wankie grog used instead of the dagga.

If Wankie grog is not going to be used, because of cost considerations then the walls should be re-bonded with dagga, especially where erosion has occurred or where the walls have bowed out of straight or perpendicular. In dismantling a furnace bonded with dagga, it will be noticed how little adhesion has developed between the fire bricks when this bonding is used.

Wood Furnaces.

There are still a great many enquiries for a good wood furnace, and the T.R.B. reverse flow type has been designed and tried out. It is a flat floored furnace, with no fire bar.

The combustion chamber is built on top of the furnace, so that all furnace radiation losses through the arch are prevented. The wood burns away from the flue end of the furnace, into the combustion chamber above; the gases going up through a central port in the furnace arch. This makes a red hot flue pipe an impossibility. The wall construction provides a heating space for air admitted to the furnace and outside of this an air space of 3in. which is sealed and effectually insulates the furnace, so that at full power the outside walls are not sensibly hot to the palm of the hand.

It has hitherto not been generally known in the Colony, that for the combustion of wood, the air is best admitted over the timber. In the furnace under review, only a white ash remains on the floor, practically no charcoal is left. Where fire bars in wood furnaces have been advocated, charcoal of necessity falls through the fire bars and is lost. As wood contains on an average 15 per cent. of its own oxygen for combustion, it is better to burn it on a flat brick floor and arrange to pass extra air over the top of the fuel bed.

In this furnace all the air admitted to the furnace is forced to mix with the volatiles generated and for this reason the furnace is exceptionally economical. The combustion is so intense that the furnace arch must be built in fire-bricks; dagga has proved an efficient bonding.

Stump Furnace.

A furnace to cope with large and heavy stumps is sometimes needed and a furnace was designed to meet this purpose.

The construction is simple. A pit 3ft. square and 7ft. deep is dug, inner edge 6ft. from the barn wall. The side of the pit remote from the

furnace is then dug away and a chain of steps led down from ground level to the bottom of the pit. Sufficient room, 4ft. between these steps and the front wall of the furnace must be left to permit of dust being raked out.

The front wall of the furnace is built up 14½in. construction (i.e., the wall parallel to and remote from the barn.) The other three sides of the pit are brick lined (4½in. walls).

At the bottom of the pit a fire brick bed is laid in halves, five bricks high; the two halves at 5in. apart at the first two courses, and then closing in until at the top course they are 1in. apart. The air control and temperature control is obtained by leaving more or less of the front of this slot open, using ordinary bricks to close the two lower openings.

The side walls are now built on to the fire brick bottom. In the beginning the lower courses are 2ft. 6in. apart. Parallel to the barn wall and 3ft. apart at right angles to the latter, a step of ½in. is made in each course. In the wall parallel to and closest to the barn wall, from the top of the furnace (ground level) a slot 9in. wide and 2ft. long is left, so that the bottom of the slot is 3ft. 6in. from ground level; both bottom and top of this slot are of fire brick (arch at top, flat on bottom). This slot forms the entrance to a tunnel 2ft. x 9in., which proceeds horizontally for 3ft. and then vertically into a combustion chamber 2ft. 6in. high, built above ground, with the usual connection to the barn flues incorporated. It is best to bond this combustion chamber into the barn wall. Over this combustion chamber leading away from an expansion chamber, formed above the combustion chamber's arch, and 1ft. 6in. high into this last space is led the discharge from the barn flues.

Operation.

Fill in grass, then brushwood to a depth of 3ft. and light. Drop in a few stumps; the brushwood will take some of the bump. As long as a carpet of charcoal is maintained, logs may be dropped in at will.

Place a sheet of 1/8th iron over the top of the pit. This plate is provided with lifting lugs, through which a piece of 3/4in. water pipe may be passed for lifting.

Control the barn temperature by the opening below the slot in the grate. When the door is on the furnace acts as an updraught furnace. When the door is off it becomes a downdraught furnace and very little inconvenience is caused to the loaders. The door may be off for a considerable period without affecting the barn temperatures.

Due to the relatively high insulation of this furnace, it is extremely economical, using about 2 cords per 16 x 16 barn, and the wood is completely consumed.

The dust must be raked out every four hours. If the dust is not kept clear, the charcoal rises to the level of the flue gas port and it is a lengthy job to get the dust clear when it has been allowed to accumulate to this extent.

When curing is completed, if the fire is allowed to burn down with the plate cover removed, the barn will not be any longer cooling down than with the normal type of furnace. The stump furnace walls and

grate will retain heat for a week, however, and hence very little trouble, if any, is encountered when loading the next barn. This feature makes the maintenance of a set temperature a much easier matter.

Flueless Barns.

The heat transmission efficiency of a set of flues of the usual type employed is seldom above 40 per cent. and it is obvious that any form of direct heating of a barn, provided the heat was obtained from coal or wood (as against oil fuel and electricity), would make for ease of control, be more economical and possibly quicker.

Accordingly a small furnace of ordinary design was built, the combustion chamber was made in a maze or labyrinth formation, so that the furnace gases were forced to traverse this maze and so deposit any dust of dirt. The ash pit was closed and provided with a 5in. steam fan developed on this station from old compressed air fans used in the mining industry. The idea was to supply an excessive amount of air for combustion, and so bring the carbon dioxide content of the gases down to about 6 per cent. which is considered a safe limit. The gases were led direct into the barn and no attempt was made to obtain diffusion for reasons explained later.

Four tiers of tobacco consisting of tops of little value were used. The first run was with coal as fuel. The percentage carbon dioxide was easily kept below 6 per cent. and the economy in fuel against normal flue curing was marked.

The tobacco immediately in the way of the discharge of the flue gases turned black in 9 hours at 90 degrees F.; that remote from this discharge coloured very quickly.

After 36 hours it was apparent that the sulphur dioxide from the coal fuel was very deleterious to tobacco. It is probable that the moisture in the tobacco forms sulphurous acid which attacks the leaf. However, it has been demonstrated that coal fuel is of no use for direct heating.

Wood: Direct Heating.

As there is little sulphur content in wood fuel, a second run was carried out with wood as fuel. There was no blackening; but the leaf assumed a dirty grey appearance. This was disconcerting at first until it was discovered that the leaf had accumulated a deposit of the dust associated with wood burning. This dust is too fine for the labyrinth to keep out. As it was impossible to see whether the leaf was colouring or not the experiment was abandoned.

With the provision of a Cottrell Dust Precipitator—worked on a small electric current—this dust could be obviated. The experiment will be continued when a precipitator can be obtained and a power supply is available.

Heat Exchanger.

The experiments with an electrically heated barn at Hillside, besides proving the uneconomic aspect of electrical heating, proved the efficiency of forced circulation in tobacco barns.

As every farmer must have steam, and very few have electricity as yet, it was considered that the circulation would be more easily and cheaply obtained by using a steam turbo driven fan.

These fans are made by Sirocco, of Belfast. The turbine driving the fan is mounted on the periphery of the latter; the exhaust steam from the turbine is passed to a radiator, which is mounted in the air flow from the fan, so that the air is circulated and heated by the unit, resulting in a great economy of heat.

As radiators were not available, the system was installed so that a fire in an heat exchanger, heated walls through which air is drawn by the suction of the steam fan.

The barn in which tobacco was drying was not allowed to discharge to the atmosphere but exhausted into a second barn in which tobacco was curing. In this way considerable economy should be possible.

No data was available, so the first step was to find out the size of heat exchanger necessary. If it had been possible to design this in cast iron this would have been easy, but owing to the cost of cast iron it was decided that farm bricks would be the best medium to use.

For initial tests, a small heat exchanger was built up of black plate 20 gauge. The fan was made to discharge into the chimney base, up the chimney and by 14½ in. pipe duct from the chimney, into the barn in the space below the eaves. The old flue pipe entrance to the barn was connected to the section of the fan, so that the latter drew air out of the barn, passed it round the heat exchanger under pressure, and from thence this heated air went up the old chimney and into the barn.

The normal circulation of air in a barn was thus reversed. Actually this is advocated, because, during the 90-95 degrees F. stage in a barn the air becomes charged with CO₂, rises to about the 6th tier and then falls down over the outside flues, resulting in uneven heating.

The barn was filled with four tiers of end of season tobacco. Colouring was obtained in 12 hours from starting and the tobacco was completely cured in four days. It was unevenly cured, however, the lower tiers were a nice bright leaf, but the upper tiers had cured too green. At no time was the temperature above 125 degrees.

Analysis of these conditions indicated that the fan was unable to draw the air down from the top of the barn, at the higher temperatures, against the natural convection. This effect was accentuated by the extensive roof and door leakage. It became obvious that as most farmers have badly fitting doors, that to obtain success, without expensive alteration, the door must be placed on the pressure side of the fan.

For the second experiment, the fan drew warm air from the heat exchanger, compressed by the fan discharge, into the space below the tobacco. It was then blown through the leaf into the space below the top tier, and drawn down the chimney by the fan suction and into the heat exchanger again. This experiment proved successful and the tobacco was good average. One disturbing factor was that with this system of circulation, the exhaust steam mixed with the discharged air from the fan. At no time was the temperature above 125 degrees F. In order to dry out the leaf the fan was turned round to discharge to the atmosphere and the heater and barn placed in the suction of the fan.

As a result of this experiment Messrs. Sirocco are producing a fan with a controlled exhaust so that in the curing stages, the proportion of steam discharged to the air flow may be adjusted to obtain the required humidity and in the drying stages may be led to a curing barn or grading shed as desired.

The experiment demonstrated the feasibility of the system and its inherent economy. In addition it proved that forced circulation in barns has the following advantages:—

- (i) Quicker curing by as much as two days.
- (ii) Enables the curing operation to be performed efficiently at temperatures below 130 degrees F., possibly resulting in a better quality leaf.
- (iii) Curing will probably be more uniform although further tests are necessary to prove this.

The whole apparatus for this experiment cost £25 which was the cost of the fan. The heating radiator with turbine and fan will cost £50 which is less than the price of a coal furnace and flue pipes.

The small iron heat exchanger was pulled down and a farm and fire brick construction substituted. This apparatus will be tested on two barns at a time; one maximum 130 degrees F. (drying) and the other at 90 degrees F., in an endeavour to ascertain if a drying barn has sufficient heat content in the exhaust to deal with a curing barn. Theoretically there is ample heat and arrangements for "spilling" excess air will be investigated.

The arrangement will be: suction of air from the atmosphere through the heat exchanger and thence through the fan into the bottom of the drying barn, up by convection to the space below the eaves and through numerous loose bricks in the party wall into the second barn at the top. It is considered that the air will be so heavy with moisture from the drying barn that there will be no difficulty in getting it to flow down the second barn and out of the door and lower vents. A second fan may be necessary but it does not appear so at present. With the use of the steam radiator units, it will only be necessary to place those at the present flue discharge point into the barn and move them from barn to barn as required so that instead of one furnace per barn, two turbine units should cope with six barns in three pairs. This should result in economy in time, material and money which is the ultimate object of this experiment. It is also hoped to eliminate the use of flue pipes. One Apex type boiler or an equivalent boiler will probably run four of these fans simultaneously but this is another point that still has to be proved in practice.

Flue Arrangements.

A study of the barns during curing revealed the existence of a permanent fall in temperature in all barns close to and just above the top of the door. At the 130 degrees F. stage in six barns studied, this temperature seldom rose above 120 degrees F. and the difference was accentuated as barn temperatures were increased.

The difference in temperature can be reduced if the bottom vents on the side opposite the door are opened to the maximum possible, dependent on the circumstances, as this reduces the suction at the door

and enables a higher temperature to be obtained there at the low temperature points.

It is now thought that the chimneys in the orthodox arrangement are placed on the wrong side of the barn and that a double exit chimney should be built around the door. Then all the air drawn through the door whether due to opening or to leakage would be warmer and dryer than is usually the case.

This arrangement would necessitate a split combustion chamber built against the barn wall and extending 3ft. each side of the centre; the main flue pipe of large diameter running along each sidewall and joining up to a second chamber going across the barn in front of the barn door. This chamber would have two exits leading to the chimney in the T.R.B. manner, now generally adopted. The system would have a smaller diameter pipe running between the two chambers and in the centre of the barn.

It is hoped to try out this system, as it should result in the following advantages:—

- (i) more even heating in the barn.
- (ii) absence of cold corners.
- (iii) counteraction of the effects of door leakage.

Red Hot Flues.

This has become an even greater trouble with coal furnaces than it was when wood was the general fuel in use. It is quite characteristic of several types of furnaces especially those which are claimed to burn either wood or coal.

As a general rule any furnace that will burn coal will burn wood; but the reverse is not the case because wood requires very much less air and the volume of gas generated per lb. of fuel is approximately one half of that resulting when coal is burnt.

The furnaces designed to burn either coal or wood are usually a straight tunnel without a baffle, in order that a long trunk may be inserted. There is no vena contracta formed, which is so essential for coal burning in order to obtain admixture of the extra air required for combustion. Wankie coal which is bituminous requires a particularly good air supply. The "Management of Coal Fires," a booklet available from the Agricultural Department, describes the best method of burning bituminous coal and should be studied by all coal users.

In one type of coal furnace, pipes are led from the external air to the bar of the firebars, so that cold air is drawn into the combustion chamber. This is a great mistake because the higher the temperatures at the back of the firebars the better the combustion. When a 3in. pipe is led into each side of the combustion space, the effect is to cool down the gases at the very point where the highest possible temperature is essential. The effect of cooling the gases is to delay the burning of carbon into carbon dioxide and the combustion is so long delayed that it occurs in the initial length of the flue pipe, and the flame coming into contact with the latter quickly burns the iron through. Tubes of fireclay are sometimes used in the initial length but this should not be necessary if the furnace is properly designed.

The cure is to blank off the extra air pipes and when firing up to leave the furnace door slightly open for five minutes or so. The provision of a baffle and a combustion chamber of adequate volume are essential. The necessity for fireclay flue pipes is a certain proof of poor design.

The radiation from the flue pipes into the barn is affected by (a) velocity and (b) initial temperature. If in two furnaces the initial temperature is the same then the gas will give up heat to the barns depending on the velocity. If the velocity is too low, the flue pipe in the initial stages will burn through after a few hours because the flue gases at the exit from the furnace are anything from 1700 degrees F. to 2000 degrees F. and if they are slowed down or are running too slowly there is more time for the flue pipe to take the heat away and it becomes overheated. Where the combustion is inefficient actual flames are running through this initial length. Any obstruction in the fire flow, such as a reduction to half size at the chimney by a "Tee" of equal size, affects the velocity in the initial length of pipe and tends to cause overheating there.

From the point of view of curing tobacco, apart from the coal consumption it is obviously better to have too high a velocity than too small, or rather it is better to err on the too high side than on the too low side. In order to guard against the latter condition the "Tee" from two pipes to one at the chimney exit should be abandoned and a double exit provided. Similarly the expensive right angled bends commonly supplied should be dispensed with as the efficiency of discharge of these is under 45 per cent. so that here again is a cause contributing to the overheating of the initial flue pipe.

It is much cheaper and more economical to provide brick boxes at the junctions and if these are made 27 inches square inside, they provide expansion chambers in the gas flow and so have a full 100 per cent. discharge efficiency. The tops of the brick boxes should be sealed with a 20 gauge (or near) steel plate and this plate can be brought up to within 2ft. of the tobacco where there has been a cold corner.

The exact ideal proportion between the cross section of the initial flue and the side flues has not yet been determined; but it would appear sufficient to make the flue pipes a constant diameter in the normal arrangement and as the tendency is to pack barns to a greater degree the 14½ in. flue pipe is recommended in place of the more usual 11 in. This 11 in. diameter was really dictated by the size of the plates as manufactured, i.e., 6ft. x 3ft. It is possible, however, to obtain plates 8ft. x 4ft. and with the expected and increasing demand for 14½ in. flues the local manufacturers will undoubtedly purchase the larger size. It is not certain that the round flue is the best section and experiments are under way to evolve an efficient flat flue. The biggest objection to the round flue is that if it is opened up after the second day at low barn temperature the bottom quarter is full of soot.

This accumulation of soot is caused by condensation of the flue gases, operating at a low initial temperature and being cooled down. There is also a low velocity due to low chimney base temperatures under these conditions, tending to soot deposition. Later on, when the higher temperatures are obtained, this soot is burnt to a characteristic grey powder. This phenomenon is thought by some to indicate a good draught but soot deposited in the early stages and burnt to a grey

powder later really indicates poor combustion. These deposits in the flues at the early stages can be avoided by a steam blower in the chimney or where the double exit chimneys have been built by keeping a small fire in the midget furnace built at each expansion chamber base.

The farmer is often resigned to removing flue pipes and cleaning out after each run. This is entirely unnecessary where the furnaces are properly designed and combustion is correct. The flues of the T.R.B. furnaces are never touched except between seasons and the present design of flue pipes makes it necessary to dismantle the whole to get at one piece.

INVESTIGATIONS INTO THE PERFORMANCE OF SEVERAL TYPES OF COAL FURNACES.

The Standard T.R.B. furnace in firebrick, but bonded with "dagga" was built in No. 9 barn, called in the analysis sheet No. 5 furnace.

A midget T.R.B. furnace, all in firebrick, but built with the bricks on the 3in. edge, instead of the usual practice of the 4½in. edge.

This saves 250 bricks, and the furnace is 3ft. high as against the 3ft. 6in. of the standard type. Called No. 1 in the analysis.

The original Simmons' furnaces had shown the usual defect: burnt out initial flue pipes; and to cure this defect the original combustion chambers were extended four feet.

The cold extra air supplies to the furnaces at the baffle were blanked off, as this feature cannot add to efficiency, resulting as it does in a reduction of combustion chamber temperature, due to the blast of cold air induced through the two pipes from the barn into the baffle. Called 2 and 3 in the analysis.

The original two furnace "Gundry" was left, as time and weather did not permit of necessary alterations. Called No. 4 in the analysis.

Nos. 1, 2 and 3 were provided with double exit chimneys 14in. square section developed by the Research Engineer.

The chimney of No. 4 was left at 13in. by 9in.

No. 5 barn was fitted with the T.R.B. special flat flues developed by the Research Engineer.

The remainder had normal flues, except for exit boxes to replace the conventional square corners.

No. 1 BARN (Midget T.R.B.).

Date & time loaded	No. of sticks	Wet weight	Date finished — if relet — two dates	Dry weight	Curing hours	1. Coal used 2. Cost per barn @ .22 per lb.	Cost of curing 1 lb. dry weight	Run No.
21.1.49 17.00	600	8,400	1.500 27.1.49	1,700	142 5dys. 22 hrs.	1. 1,454 lb. 2. £1/6/8	.18d.	1.
10.2.49 Noon	820	11,480	Noon 16.2.49	2,300	144 6 days	1. 2,286 lb. 2. £2/2/0	.21d.	2.
3.3.49 15.00	850	12,325	1.600 11.3.49 Relit, 18.00 16.3.49 till 06.00, 18.3.49	2,550	193 plus 46- 239 = 9 days 13 hours	1. 2,370 lb. 2. £2/3/5	.204d.	3.
22.3.49 11.00	850	12,300	1.600 29.3.49	2,450	173 7 days, 5 hrs.	1. 2,710 lb. 2. £2/10/0	.2d.	4.
5.4.49 12.00	750	11,250	1.200 14.4.49	2,210	9 days	1. 2,814 lb. 2. £2/11/6	.28d.	5.
22.4.49	750	11,200	1.400 30.4.49	2,300	8 days 2 hours	1. 2,750 lb. 2. £2/10/0	.26d.	6.

No. 2 BARN (Simmons Furnace with added combustion chamber).

Date & time loaded	No. of sticks	Wet weight	Date finished — if relet — two dates	Dry weight	Hours curing	1. Coal consumed 2. Cost per barn @ .22 per lb.	Cost of curing 1 lb.	Run No.
24.2.49 1600	740	10,730	4.3.49 0600	2,120	182 hours 7 days 14 hours	1. 3,512 2. £3/4/0	0.31d.	1.
12.3.49 0600	580	8,700	20.4.49 0700	1,700	193 hours 8 days 1 hour	1. 3,500 2. £3/4/0	0.45d.	2.
29.3.49 Noon	580	8,750	5.4.49 Noon	1,720	168 hours 7 days	1. 3,402 2. £3/2/0	0.44d.	3.
12.4.49 1300	500	7,500	22.4.49 1600	1,600	243 hours 10 days 3 hours	1. 3,150 2. £2/17/0	0.43d.	4.

No. 3 BARN (Simmons Furnace with extended combustion chamber).

Date & time loaded	No. of sticks	Wet weight	Date & Time finished	Dry weight	Hours curing	1. Coal used 2. Cost per barn @ .22 per lb.	Cost in d. to cure 1 lb.	Run No.
Wed. 16.2.49	11,620	830	Sun. 20th 24.00, shut down by boy without orders. Relit 28th. 06.00 Fin. 2nd Mar. 06.00	2,300	150 hours 6 days 6 hours	1. 3,844 plus 364 (relit) 2. £3/10/0 £3/17/0 (relit)	1. .35d. .40d.	1.
Fri. 4.3.49 1300	11,250	750	Mar. 11th 13.00 Relit 13th Mar. 08.00. Fin. 15th Mar. 12.00	2,270	220 hours 9 days 4 hours	1. 4,082 plus 882 (relit) 2. £3/14/0 £4/9/0	0.4d. 0.46d.	2.
Wed. 23.3.49 1800	11,340	750	31st Mar. 16.00 Relit 8th April 16.00 Fin.: 10th April 07.00	2,268	190 hours plus 39 229 hours 9 days 13 hours	1. 4,076 plus 560 (relit) 2. £3/14/0 £4/5/0 (relit)	0.4d.	3.
15.4.49 Noon	7,000	500	23.4.49 07.00	1,500	187 7 days 17 hours	1. 3,628 2. £3/6/6	0.52d.	4.

No. 4 BARN (Gundry double furnace coal type).

Date & time loaded	No. of sticks	Wet weight	Date & Time finished	Dry weight	Hours curing	1. Coal consumed 2. Cost per barn @ .22 per lb.	Cost of curing 1 lb. Dry weight	Run No.
23.2.49	913	12,782	3.3.49 18.00	2,500	245 10 days 5 hours	1. 3,818 2. £3/10/0	.38d.	1.
8.3.49 17.00	300	4,500	17.3.49 18.00	896	217 9 days 1 hour	1. 4,020 2. £3/13/0	.98d.	2.
21.3.49 13.00	714	10,710	31.3.49 06.00	2,142	233 9 days 17 hours	1. 4,170 2. £3/16/0	.43d.	3.
7.4.49	450	6,525	15.4.49 20.00	1,320	198	1. 3,6434 2. £3/6/0	0.6d.	4

No. 9 BARN (T.R.B. standard type. Bonded with dagga).

Date & time loaded	No. of sticks	Wet weight	Date & Time finished	Curing hours	Dry weight 1. Coal consumed 2. Cost per barn @ .22 per lb.		curing 1 lb. leaf dry wt.
31.1.49							
Noon	780	11,310	7.2.49 16.00	2,340	172 7 days 4 hours	1. 1,784 2. £1/12/2	0.12d. 1.
25.2.49							
Noon	810	12,150	11.3.49 16.00	2,430	342 14 days 6 hours	1. 2,986 2. £2/14/0	0.26d. 2.
17.3.49							
13.00	580	8,120	25.3.49 Noon	1,700	191 7 days 23 hours	1. 2,198 2. £2/0/0	0.28d. 3.
4.4.49							
12.00	500	7,560	12.4.49 16.00	1,540	196 8 days 4 hours	1. 2,366 2. £2/3/0	0.33d. 4.

COMPARATIVE ANALYSIS.

		T.R.B. MIDGET No. 1 BARN	SIMMONS No. 2 BARN	SIMMONS No.3 BARN	GUNDRY No. 4 BARN	T.R.B. Standard No. 9 BARN
Dry	1st Run	1,700	2,120	2,300	2,500	2,340
	2nd "	2,300	1,700	2,270	896	2,430
	3rd "	2,550	1,700	2,270	2,152	1,700
Weight	4th "	2,450	1,600	1,500	1,320	1,540
	5th "	2,210				
Cured	6th "	2,310				
lb.	av.	2,253	1,785	2,084	1,715	2,002
	1st Run	1,454	3,512	4,208	3,818	1,784
	2nd "	2,286	3,500	4,082	4,020	2,986
Coal	3rd "	2,370	3,402	4,076	4,170	2,198
	4th "	2,710	3,150	3,628	3,634	2,366
burnt	5th "	2,814	Total	Total	Total	Total
	6th "	2,750	13,564	15,994	15,642	9,324
lb.	Total	14,384				
	av.	2,397	3,341	3,998	3,910	2,331
	1st Run	£1/6/8	£3/4/0	£3/17/0	£3/10/0	£1/12/7
	2nd "	2/2/0	3/4/0	4/9/0	3/14/0	2/14/0
	3rd "	2/3/5	3/2/0	4/5/0	3/16/0	2/0/0
Cost	4th "	2/10/0	2/17/0	3/6/6	3/6/0	2/3/0
per			Total	Total	Total	Total
barn	5th "	2/11/6	£12/7/0	£15/17/6	£14/6/0	£8/9/7
	6th "	2/10/0				
	av.	£13/3/7 £2/3/10	£3/1/9	£3/19/5	£3/11/6	£2/2/1
Cost	1st Run	0.18	0.31	0.39	0.33	0.12
in d.	2nd "	0.21	0.45	0.49	0.98	0.26
per/lb.	3rd "	0.24	0.44	0.4	0.43	0.28
leaf	4th "	0.24	0.43	0.52	0.60	0.33
dry	5th "	0.28				
wt.	6th "	0.26				
	av.	0.235	0.407	0.44		
Cost		2350d.	4070d.	4400d.	5850d.	2475d.
per						
1,000						
lb.						
DRY						
wt.						
OR		£9/5/10	£16/19/2	£18/6/8	£24/7/6	£10/6/3

When comparing the figures it must be realised that the "Gundry" furnace has a single exit chimney and that time did not permit of adding a proper combustion chamber; whereas the two Simmons furnaces had double exit chimneys and combustion chambers nearly three times the volume of the original construction.

Light Loading of Barns.

The Gundry barn was only loaded with 300 sticks for one run (No. 2) and it is interesting to see how the cost of curing per pound of leaf jumped up from an average of around 0.4d. to 0.98d. this is again empha-

sised in the fourth run on this same barn where the curing figure is doubled.

Heavy Loading of Barns.

The maximum loading was on the 3rd and 4th runs of No. 1 barn, in both cases 850 sticks were loaded (wet weight about 12,300lb.) and the cost in pence per lb. just under one farthing; from the records of this barn it would seem that for a Standard 16 x 16 x 20 barn, 800-850 sticks with a wet weight of 14½lb. per stick is the most economical loading, provided the top ventilation opening exceeds 30 sq. ft.

Flues.

The only red hot flue pipe was encountered in the "Gundry" furnace solely because the very successful "Gundry" wood furnace design had been copied into a coal furnace, yet another proof of the fact, that you cannot have a furnace which will burn both coal or wood efficiently.

The T.R.B. flat flues fitted in No. 9 barn have shown their efficiency in the result obtained, the initial flue suffered some heat distortion and its dimensions will be reduced slightly in order to get a higher velocity in this section and so avoid this local heating.

Examination of Furnaces.

No. 1 Midget: The arch was lifted over the combustion chamber, which had a carpet of fine ash one inch deep, there was no sign of soot. There were signs of erosive action just above and behind the hollow baffle, where the combustion is completed.

No. 2 Simmons: The semi-circular arch had suffered considerable erosion of the bonding at the joints, this bonding is in a form of asbestos cement and eventually the wear and tear will necessitate renewal in one of the proprietary bondings. All firebars distorted and burnt.

No. 3 Simmons: The bricks bordering the dead plate are much worn and the arch at the furnace door end will require renewal. The firebars will require complete renewal. This is a serious expense, and is probably caused by the lack of a water container in the ash pit which with coal furnaces is a necessity, if firebars are to be preserved.

No. 4 Gundry: The doors of this furnace were made up in one quarter inch steel plate, and were warped and distorted beyond repair. As the furnace is of such poor design for coal burning it will be dismantled.

No. 9 T.R.B.: This furnace is the Standard T.R.B. bonded with dagga and it opened up in very good condition. The top course of baffle bricks will require resetting, as the bonding has burnt away. This baffle will be reset using fireclay, crushed firebricks and ganister, to see if the top of the baffle can be made more permanent. If this can be arranged it will only be necessary to open up the arch every three years, or until the baffle brick bonding has burnt away.

Trials will also be made with a cast iron top to the hollow.

Farmer's Boiler: The half-scale model was thoroughly tested by connecting to the grading shed. This model had been in use on well water for a year at Hillside, and it was now run on borehole water.

The native in charge was not an expert, and the boiler was more often short of water than anything else, and eventually the element tube burst on one corner. The fire was extinguished and a slight hissing proclaimed the tube perforation.

The full scale unit was erected and tried out, and after various teething troubles was successful. The cost will be under £50 complete, and a new element (the only part to wear) can be purchased for £10; this means a new boiler for ten pounds every three years, if borehole water is used; if rain water is used the boiler should last a lifetime.

Bottom Vent Heating: The entry of comparatively cold saturated air from the atmosphere into a barn at between 135 and 160 degrees F. constitutes one of the big losses in efficiency in the curing process, during wet weather.

A steam heated unit was designed to enable this air to be heated to the barn temperature.

These units were designed to fit into the bottom vents, on the side of the barn opposite to the door, as any ventilation open on this wall tends to nullify door leakage. These units might be too expensive for general use.

Furnace with Bottom Vent Heating.

To overcome the previous cost objection, an outside coal furnace was designed and built, with a chamber built over the top of the combustion chamber arch. The chamber is made to communicate to the bottom vents on the side opposite the door. On the door wall of the barn, the bottom vents are led into a chamber formed under the brick corners of the flue system; so that the air drawn in on one side is heated in the space over the combustion chamber, and that on the other side of the barn, in the chamber formed beneath the flue pipes.

This furnace is now under trial, and should provide a means of curing the cold spots, now existing in barns, and which are primarily due to drawing in cold air in large volumes into the barn, and secondarily due to lack of adequate top ventilation. In the latter case it must be remembered that the barn is a huge chimney with a base temperature twice the ordinary atmospheric temperature and any restriction to the passage of air out of the barn, at its top retards the drying effect in the barn and may cause the deposition of moisture on the leaf.

The curing season usually occurs at the time of the heaviest rainfall; hence any method of warming and drying the practically saturated cold air admitted to the barn, must be economical, and tend to create a more even temperature in the barn.

Conditioning Tobacco.

The majority of farmers boilers are injector fed; this necessitates working at a minimum steam pressure of 30lb.; this can be reduced to 25lb. by elevating the feed tank above the ejector; but even so the temperature of the steam emerging will build up to around 240 degrees; it will be realised that it is easily possible with an injector fed boiler to cook the tobacco in the lower tiers by a careless manipulation of the steam nozzle.

The same defect can be developed in an ordinary conditioning pit.

The T.R.E. tube humidifier by expanding the steam and providing water in intimate admixture with the steam, makes it impossible to injure the tobacco, the hand can be held directly over the discharge holes—when the full operating pressure of 35lb. is being used.

If the humidifier is considered too expensive an expanding nozzle has been designed to screw into the end of the steam supply to the barn, and is available at about 15/- in Salisbury; here again the steam is expanded to a very much lower temperature with an increase in velocity and if the discharge from the nozzle is made to play on to a piece of old flue pipe, the resulting low temperature vapour can be directed to any required portion of the barn with safety.

Conditioning Pits: It would not be unfair to say that each conditioning pit of the usual design, spoils a pound of leaf per day at a conservative estimate.

The main reason is because the steam pipe usually has slots pointing upwards, and steam at too high a temperature is blown upon the leaf, which is cooked and spoiled.

If the steam is made to blow downwards to the bottom floor of the pit, and suitable half bricks are removed in the side walls, it will be found that the steam will cannon off the bottom of the pit, and rise up the side walls, and draw with it a certain amount of air, and becoming cooler throughout its course, so that by the time it gets among the tobacco, it has lost any possible high temperature effect.

It is most strongly recommended that farmers who have injector-fed boilers, should fit a hand pump of sorts, in order that the boiler when grading or conditioning tobacco can be operated at 5lb. pressure. The resulting additional volume of steam generated at less expense for fuel will pay for the hand pump, and it will be impossible to spoil the leaf through high temperature effects. The temperature of steam at 5lb. pressure is 162 degrees F. A new conditioning pit has been designed and a drawing will be made available.

IX. Turkish Tobacco Investigations

Introduction.

Investigations into the culture of Turkish Tobacco were begun on a small scale during the 1948-49 season. The station Turkish crop compared well with the average for the Colony. In spite of the unfavourable season for Turkish, the crop yielded in the region of 600/700lb. per acre, as against 450 for the Colony. As regards quality, one fourths of the leaf graded out amongst the top or American grades. It may be said that the production of the crop was satisfactory, the grading facilities adequate, and the price obtained normal for the Colony.

As the plots were not laid out according to a recognised randomised system, the indications obtained from the initial experiments must be regarded as tentative only, and the work will have to continue over several seasons before any final conclusions can be made. An attempt has been made, as far as seems warranted, to extract certain figures from the available data, and interpret certain observations of an elementary character, which may be of value for reference purposes. Technical terms have been avoided and nothing in the nature of a statistical analysis has been attempted in the evaluation of the results.

Land.

The Turkish trials were conducted on light pinkish sandy soil, typical of the Trelawney area. The sites elected had a northerly exposure on adjacent contour terraces. The land was the first opened on the Station, but it had not been under cultivation during recent years. A few isolated pockets of eel-worm infestation were subsequently revealed. Less than a hundred plants showed signs of infection.

Season.

The season was unfavourable for Turkish. This was evidenced in the prevalence of unusually late rains, which contributed to decline in quality. Regular reaping was interfered with on several occasions. There followed a period of extremes between day and night temperatures, coupled with cold winds. The disappearance of a "green fly" infestation, and the incidence of "white mould" (Erysiphe) on certain varieties, coincided with this climatic change. In all other respects, the leaf was free from disease.

Spacing and Manurial Trial.

The spacing and manurial treatments were as follows:—

Standard Turkish Fertiliser:	
3N : 9P : 9K mixture.	
Spacings:	
(1) 18 in. x 4in.	Level A: 150lb. per acre.
(2) 18in. x 6in.	
(3) 18in. x 9in.	Level B: 200lb. per acre.
(4) 18in. x 12in.	
(5) 24in. x 6in.	Level C: 300lb. per acre.

The spacing treatment plots were approximately 1/35th of an acre, and the manurial treatment sub-plots were approximately 1/106th of an acre. There were five replications of each spacing treatment, and each spacing treatment had, in turn, five replications of each level of fertiliser application.

The variety under test was Station Soulook. A type of necrosis, giving a dead appearance at the tips, developed on some of the leaf. This was probably due to "sun scorch." In certain plots said to have suffered with "wet feet," the growth was stunted, but the quality high; the leaf grading out almost entirely in the topmost grade.

Sub-plots were prefertilised, by broadcasting. Further details were as follows:—

26th January, 1949—Planted.

3rd February, 1949—Re-filled.

3rd March, 1949—Cleaned and ridged up.

4th April, 1949—Primed.

9th April, 1949—1st reaping.

4th June, 1949—Last reaping.

The following Table No. 1 sets out the results of the graded leaf:—

(See pages 80 and 81)

TABLE 1.
Spacing and Manurial Trial: showing Yields and percentages of
Graded Leaf with five different spacings and at three levels
of 3N.; 9P.; 9K. Fertiliser.

LEVEL A. 150 lb. per acre. Spacings:	TOPMOST OR AMERICAN GRADES		INTER- MEDIATE GRADE	LEAF GRADE	CON- TINENTAL GRADE	TOTALS Weights for 5 replications	YIELDS per acre (approx.)
	AM1 (lb.)	AM2 (lb.)					
(1) 18" x 4":	9.08	13.37	6.93	0.99	1.61	31.98	678
(2) 18" x 6":	28.39% 9.31	41.81% 11.15	21.67% 8.42	3.10% 1.02	5.03% 1.07	30.97	657
(3) 18" x 9":	30.06% 8.58	36.00% 15.79	27.19% 4.79	3.29% 0.88	3.45% 1.38	31.42	686
(4) 18" x 12":	27.31% 8.05	50.25% 14.38	15.25% 6.18	2.80% 2.00	4.39% 1.49	32.10	681
(5) 24" x 6":	25.08% 8.81	44.80% 7.81	19.25% 12.92	6.23% 1.47	4.64% 1.68	32.69	693
	26.95%	23.89%	39.52%	4.50%	5.14%		

LEVEL B. 200 lb. per acre. Spacings:	TOTALS					YIELDS per acre (approx.) (lb)
	AM1 (lb)	AM2 (lb)	Y7 (lb)	Y6s (lb)	C (lb)	
(1) 18" x 4":	11.81	7.33	5.39	0.45	1.21	26.20
(2) 18" x 6":	45.08%	27.98%	20.57%	1.76%	4.62%	6.69
(3) 18" x 9":	8.62	10.02	8.03	0.80	1.23	28.11
(4) 18" x 12":	29.99%	31.84%	28.11%	2.78%	4.24%	6.10
(5) 24" x 6":	8.12	14.25	4.39	1.01	1.01	28.78
	28.21%	49.51%	15.25%	3.51%	3.51%	6.51
	7.66	13.05	3.09	0.65	1.15	26.00
	29.46%	51.73%	11.88%	2.00%	4.42%	6.56
	7.50	10.66	13.93	2.15	1.42	6.56
	21.03%	29.89%	39.06%	6.03%	3.85%	

LEVEL C. 300 lb. per acre. Spacings:	TOTALS					YIELDS per acre (approx.) (lb)
	AM1 (lb)	AM2 (lb)	Y7 (lb)	Y6s (lb)	C (lb)	
(1) 18" x 4":	10.02	9.28	6.89	0.76	0.96	32.91
(2) 18" x 6":	35.90%	33.25%	24.69%	2.72%	3.44%	6.83
(3) 18" x 9":	10.18	11.06	8.45	1.21	1.81	32.71
(4) 18" x 12":	31.12%	33.81%	25.83%	3.70%	5.53%	6.63
(5) 24" x 6":	7.52	12.39	4.51	1.00	1.15	26.57
	28.32%	46.63%	16.97%	3.76%	4.33%	30.50
	6.58	16.38	4.94	1.73	0.87	6.47
	21.57%	53.70%	16.20%	5.67%	2.85%	31.00
	8.59	13.03	6.60	0.66	2.12	6.57
	27.71%	42.03%	21.29%	2.13%	6.84%	

Discussion.

In the manurial treatments, there were no striking trends in response to the different levels of application on the quality of the leaf. On the other hand, the quantity of graded leaf tended to be influenced by different levels of application of 3N:9P:9K Standard Turkish Fertiliser mixture, viz., 150, 200 and 300lb. per acre. The highest yield was approximately 750lb. per acre, while the lowest was about 550lb. There was a tendency for the lightest application, viz., 150lb. per acre level of application of the standard mixture, to produce heavier yields from all the different spacing treatments, except the 24in. x 6in. spacing, where the response to a 50lb. addition of the mixture per acre was only an 8 per cent. increase in yield and the spacing 18in. x 6in., with double the application, showed less than a 5 per cent. increase. The lowest yields tended to be associated with the 200lb. per acre level of application in all the 18in. row spacings, viz., 18in. by 4in., 18in. x 6in., 18in. x 9in., and 18in. x 12in., whereas the 24in. row spacing, viz., 24in. x 6in., showed a relatively high yield.

In the spacing treatments, there was less variation in the resulting yields per acre. The difference in yield did not exceed 50lb. per acre from the 18in. row spacings. As regards quality, the highest percentage of the topmost American grade came from the closest spacing, viz., 18in. x 4in., and this proportion of quality leaf diminished gradually as the spacing increased. Though the relative yield was high from the 24in. x 6in. spacing, it tended to contain more lower grade leaf with less body, and the relative amount of the topmost grade was less than in the corresponding 18in. x 6in. spacing.

Varietal Trial.

The seed for the varietal trial was obtained from the Turkish Tobacco and Plant Breeding Station, Umgusa, Matabeleland, Southern Rhodesia, where work on Turkish has been carried on for several years. The origin of the initially imported seed is not known; but certain strains, selections and crosses, as their present names imply, emanated from the Elsenburg Tobacco Station, Western Province, South Africa, while others are the result of selection and seed-bulking at the Southern Rhodesia Government Station, or by private enterprise. The seed has been acclimatised for Southern Rhodesian conditions pertaining to Matabeleland. At Trelawney in Mashonaland, the season is later, the normal rainfall heavier, and the sand veld soil lighter and poorer.

The six so-called varieties of Turkish Tobacco under test, were as follows:—

Station Soulook.
Union Soulook.
Soulook Fynn.
Elsenburg-Turk.
Samsoun Type.
Kavalla.

There were six replications of each. The plots were approximately 1/74th of an acre. They were pre-fertilised at the rate of 150lb. per acre

3N:9P:9K Standard "Turkish" Fertiliser, and ridged up at 18in. between rows with 6in. between plants. Further details were as follows:—

27-28 January, 1949.	Planted
3 February, 1949.	Re-filled
3 March, 1949.	Fertilised (broadcast between ridges) at the rate of approximately 100lb. per acre.
25 March, 1949.	1st Reaping.
6 June, 1949	Last Reaping.

The following Table 2 sets out the results of the graded leaf:—

TABLE 2.

Varietal Trial: showing Yields and percentages of the Graded Leaf from six different varieties and strains of "Turkish" Tobacco.

Varieties and Strains	TOPMOST OR AMERICAN GRADES		INTER-MEDIATE GRADE	GREEN LEAF GRADE	CONTINENTAL GRADE	TOTALS Weights for 6 replications	YIELD per acre (approx)
	AM 1 lb.	AM 2 lb.	Y 7 lb.	Y 6s lb.	C lb.	lb.	lb.
Station "Soulook"	19.88 30.23%	40.52 61.62%	2.14 3.25%	0.19 0.29%	3.03 4.61%	65.76	811
Union Soulook	19.41 33.30%	33.40 57.31%	3.16 5.42%	0.29 0.50%	2.02 3.47%	58.28	719
Soulook Fynn	19.05 33.91%	31.96 56.90%	1.74 3.10%	0.90 1.60%	2.52 4.49%	56.17	693
Elsenburg -Turk	13.75 27.00%	29.88 58.69%	4.20 8.25%	1.47 2.89%	1.61 3.16%	50.91	628
Samsoun type	15.96 31.47%	27.73 54.67%	5.45 10.75%	0.37 0.73%	1.21 2.39%	50.72	626
Kavalla	8.03 31.00%	4.71 18.18%	10.14 39.14%	0.03 0.12%	3.00 11.58%	25.91	320

Spacing: 18" x 6".

VARIETAL TRIAL.

Discussion: The Soulook varieties and strains gave the most promising results, both in the field and in the grading. Of these, the Station strain of Soulook showed the highest yield (approx. 800lb. per acre), and the highest percentage of American grade leaf (91.85% AM1 and AM2). In the topmost American grade it did not quite reach the level of the other Soulooks, obtaining 30.23% AM1, and falling short by a little over 3%. It had the highest proportion of the second top American grade of all the varieties (61.62% AM2). With the exception of Kavalla, it showed the highest percentage of the Con-

tinental grade, but this amounted to only 4.61% C. of the total yield.

The other Soulooks—Union Soulook and Soulook Fynn—gave very similar results. Their yields were about 100lb. per acre less than the Station strain, but with a rather higher percentage, of the topmost American grade (33.30% AM1 and 33.91% AM1, respectively, and a rather lower Continental grade (3.47% C. and 4.49% C. respectively). Soulook Fynn showed the lowest percentage of the Intermediate grade (3.10% Y7), as compared with the Station Soulook (3.25% Y7), and the Union Soulook (5.42% Y7).

Samsoun and Elsenburg-Turk (which is reputed to be a hybrid cross between Samsoun and Soulook), showed little variation as regards yield. (approximately 600lb. per acre) and the graded product. It was noticeable in the field that the Samsoun plots contained mixed plants; some having leaves with "ruffles" (auricles) of the Soulook type. With the admixture of Soulook type leaves, the grading figures may appear higher than they warrant. The leaves without ruffle though smaller than usual for the type, had a distinctive bright colour. Elsenburg-Turk is somewhat similar to the Soulook strains, but it did not give us heavy a yield. It showed a higher proportion of green leaf than the other varieties, though it was only 2.89 per cent. Y6s of the crop. On the whole, the leaves tended to lack body, and the relative amount of the topmost American grade was lowest for this variety.

The Kavalla crop was promising in the early stages of growth, but it turned out disappointing. The variety is reputed to be very susceptible to "white mould," which caught it in the field. Had it not been for continuous reaping, the effect might have been considerably worse. As it was, a large amount of leaf had to be discarded in the field, with the result that the harvested leaf only reached about 300lb. per acre. The plants were stunted in growth, and the leaves, though more numerous than on other varieties, were minute, particularly at the later pickings. The quality of the healthy leaves was exceptionally high in every respect, as is borne out by the graded product (31.00 per cent AM 1). There was a tendency in grading for the lowest grade (11.58 per cent. C) to find its way into the higher grade (39.14 per cent. Y7). This was mainly due to overlooking blemish in the leaf, resulting from "white mould," which was apparent in the field, a green spottiness on the earlier pickings, and "copper sickness" on the later pickings, both of which appeared during curing on the racks. The area of "dead" leaf was too high to allow inclusion in the higher grades. Given a more favourable season, Kavalla should show better results.

New Varieties.

Ten new varieties were planted out in strip nursery plots, for observation and seed-bulking. The strips were of varying lengths, and numbers of rows, according to the number of plants available for transplanting. The spacing was uniform for all varieties, viz., 18in. x 6in. Further details were as follows:—

28th January, 1949—Planted.

7th February, 1949—Fertilised (broadcast) at the rate of 200lb. per acre Standard "Turkish" 3N:9P:9K mixture.

3rd March, 1949—Cleaned and ridged up.

13th April, 1949—1st reaping.

During April, 1949—Bagged for seed.

7th June, 1949—Last reaping.

The following Table No. 3 sets out the results of the graded leaf:—

TABLE No. 3.

New Varieties: showing yields and percentages of Graded Leaf from strip nursery plots containing ten "unnamed" varieties.

	TOPMOST OR AMERICAN GRADES		INTER- MEDI- ATE GRADE	GREEN LEAF GRADE	CON- TINEN- TAL GRADE	TO- TALS Weights for each Nursery Plot	YIELD PER ACRE Approx.
Variety	AM 1 (lb.)	AM 2 (lb.)	Y 7 (lb.)	Y 6s (lb.)	C (lb.)		
No. 1	0.16 12.90%	0.76 61.29%	0.18 14.52%	0.01 0.81%	0.13 10.48%	1.24	783
Variety No. 2.	0.13 4.13%	1.99 63.17%	0.86 27.30%	0.08 2.54%	0.09 2.86%	3.15	627
Variety No. 3.	0.58 20.57%	0.67 23.76%	0.87 30.85%	0.21 7.45%	0.49 17.38%	2.82	780
Variety No. 4.	0.25 8.56%	2.10 71.92%	0.29 9.93%	0.24 8.22%	0.04 1.37%	2.92	581
Variety No. 5.	0.28 8.64%	1.85 57.10%	0.63 19.44%	0.45 13.89%	0.03 0.93%	3.24	611
Variety No. 6.	0.65 15.89%	1.29 31.54%	1.50 36.67%	0.50 12.22%	0.15 3.67%	4.09	407
Selection from Variety No. 6.	0.13 14.94%	0.18 20.69%	0.44 50.57%	0.08 9.20%	0.04 4.60%	0.87	
Variety No. 7.	1.21' 38.91%	1.14 36.66%	0.51 16.40%	0.05 1.61%	0.20 6.43%	3.11	627
Variety No. 8.	0.33 1.72%	9.05 70.81%	1.77 13.85%	1.06 8.29%	0.68 5.32%	12.78	634
Variety No. 9.	1.06 7.94%	6.43 48.16%	2.31 17.30%	2.63 19.70%	0.92 6.89%	13.35	497
Variety No. 10.	1.25 6.54%	11.12 58.19%	4.44 23.23%	1.16 6.07%	1.14 5.97%	19.11	569

Spacing: 18" x 6"

Discussion.

Of the ten new varieties, the most promising, both in the nursery plots and on grading, were Nos. 1, 7 and 10. They would appear to be

good yielders of high quality Turkish, and suited to Trelawney conditions during the season. The origin of the seed is not known, but Nos. 1 and 7 are probably Smyrna types.

No. 1 showed good texture and shape of leaf. Similarly with No. 7 which, however, is rather coarser than No. 1. Both produced in the region of 75 per cent AM1 and AM 2 American grades. The fact that No. 1 graded out at 12.90 per cent. AM 1—the topmost American grade, and 61.29 per cent AM 2—the second top American grade, may be accounted for by the scarcity of plants; resulting in their growing out too much. With a denser population, the results should be more promising. No. 7 occupied a plot three times the size; and grading worked out at 38.91 per cent. AM 1—the topmost American grade. This was almost the highest percentage of top grade from any plot during the season. Variety No. 10 showed good texture and colour.

Of the other new varieties, No. 3 had good texture, body and colour. Though the crop as a whole was not good, certain leaves were of high quality, which would point to improvement after selection. No. 4 showed the highest percentage of American grades (8.56 AM 1 and 71.92 per cent. AM 2), but the texture was only fair, and the crop was subject to "white mould." Similarly, Variety No. 8 showed a large proportion of the second top American grade (70.81 per cent. AM 2), but here again the texture was only fair. A selection from No. 6, exhibiting unusually round-shaped leaves, did not come up to expectations on grading.

Due to the limited quantity of seed available, it was not possible to lay out uniform plots, hence, the influence on the yield of the different varieties, and the marginal effects on the growth of the plants, precluded the deduction of reliable data, and true comparisons between varieties. However, certain observations have been recorded, subject to subsequent confirmation over a series of more comprehensive trials. Nevertheless, it is doubtful if any of these new varieties will compare favourably, as regards yield and quality, under local conditions, with the Soulook strains.

Seed Selection.

Good, medium-sized plants with medium-sized leaves of good body, gumminess and light colour, were selected for seed-bulking. Experimental trials might well be carried out to ascertain the relative merits of selected as against imported, seed; and further to test for evidence of deterioration in acclimatised seed. When cleaning and treating seed, it has been the common practice to discard light seed, though it has not yet been established whether this is necessary.

Reaping.

If circumstances permit, constant reaping of a leaf or two from each plant appears preferable. This was borne out particularly in the case of the plants infested with "white mould," where a marked arrest of the spread of the infection was effected. The late rains during the harvesting period tended to wash off the gum. As the aroma of Turkish Tobacco is associated with this resinous exudate from the glandular hairs, it will be readily appreciated how inclement weather during reaping can divest the leaf of its most prized attribute.

Wilting.

Wilting the freshly strung leaf under a grass-covered shed for 36/48 hours until the colour began to run was the general practice. Though not favoured locally by old established growers of Turkish, the results were promising. Further investigations into the optimum period and conditions of wilting are necessary.

Stringing.

It was found that the use of waxed twine, not only facilitated stringing, but also prevented strands of hemp, and fluff from cotton, adhering to the split midrib of the leaf. The rolls of twine were treated by immersion in boiling paraffin wax for a few minutes. Smoking tests of the butt-end of the leaf including the perforated midrib, did not reveal any taint from the wax. It is understood that an elaborate plant for treating string is being installed.

A preliminary trial has been made with reed sticks, to which the strings of threaded leaf were attached; thus facilitating handling of the strung leaf at all stages of the curing and bulking. Freshly cut reeds, stout enough to carry the weight of green leaf, were found to be suitable. They dried out on the racks, and went with the cured leaf into the bulks. Virginia barn sticks, or bamboos, proved too cumbersome.

Curing.

The "hung-as-strung" method of curing, whereby the leaves are not opened out along the strings on the racks, showed promise, though it prolonged the curing process. There was a tendency for the leaves to retain more bloom and body, with less injury and breakage. It has yet to be confirmed that the incidence of "copper sickness" during curing was increased by adopting this practice. When occasion offered, "dew-soaking" proved an aid in eliminating "greenness" and encouraging "colour-run" among the later pickings. When racks are not too high, bare ground sprinkled with sand beneath the leaf helps curing. Damage to leaf on racks was caused by inadequate protection. A simple yet secure method of covering racks has yet to be evolved.

Bulking.

Under an iron roof, bulks require a great deal of attention to maintain condition in the leaf. "Mist-spraying" was a decided improvement on low-pressure steam for conditioning leaf.

Summary of Results.

Subject to subsequent confirmation, it would appear that sparing manurial treatment, coupled with close planting, produces quality leaf, and that the Soulook strains are best suited to local conditions. It is apparent that there is ample scope for new work on improved methods of culture, and processes of handling of Turkish Tobacco under the conditions prevailing in Southern Rhodesia.

